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A SELF-EXPLANATORY CORRESPONDENCE.

Widespread interest has been developed amongst the fraternity over the possibilities so much more than hinted at in the able and exhaustive paper on fuel gas as presented to the last convention of the American Association, by Mr. Emerson McMillin, Vice-President and General Manager of the Columbus (Ohio) Gas Light and Coke Company. If we mistake not it was but a comparatively short while ago that we felt called upon to dissent from a proposition that emanated in England regarding the status of our home engineers. The authority, and we readily concede its undoubted prominence and the signal ability of its conductors, was no less a one than the London *Journal*, but on the occasion in question we think its deduction was altogether wrong. Briefly stated the *Journal* gave as its opinion that American gas engineers seemed to be men of business first and engineers afterwards, and attempted to support that opinion from a study of their utterances at the various meetings of our gas associations. Perhaps the business feature does crop out prominently at such gatherings in this country, and with much greater frequency than is the case on like occasions on the other side of the water, but the conditions which govern the manufacture and sale of gas here and abroad widely differ. Quite frequently the engineer of a small and often of a medium or large-sized plant as well is also obliged to carry on the executive management of his company's affairs. In fact, outside of our very largest centers of population and trade, the example in which the engineer or superintendent does not also write himself down as secretary or treasurer, or both, forms the exception and not the rule. With such a state of affairs, made necessary on the simple score of economy because of the facility possessed by the public of satisfying its artificial lighting needs by resorting to the greatest competitor of the American gas maker—cheap and good kerosene oil—it is therefore not to be wondered at that, in discussing subjects connected with gas engineering, the engineer will occasionally merge himself into the secretary or the treasurer. Indeed, we are not sure but these lapses result in benefit to the better mutual understanding of the topic under debate.

Aside, however, from all such speculations and explanations, we think both English and Continental engineers will find much to interest them in Mr. McMillin's fuel gas theories, or rather, practical suggestions. We are also disposed to offer it in evidence as proof that the technical and business divisions of gas manufacture need not necessarily be divorced when the manufacturers are gathered together in assembly to ventilate the progress of a year in their craft. We presume that now the subject of fuel gas has ten advocates and fifty students in America to the one attracted to it on the Continent, although it is quite likely that the reverse was the case some ten or even a less number of years ago. The wonderful natural gas developments in the Pittsburgh, Findlay, and other regions have taught us the great value and exceeding convenience of a gaseous fuel in the homestead as well as in the factory or the workshop. And while originally many were disposed to adjudge Dr. Siemens an enthusiast of the most pronounced type, when he suggested the approach of the day in which coal would be turned into gas at the pit's mouth, the followers of his theory at the present time are perhaps numerically as strong as were the doubters before. The prevailing opinion, and one that becomes stronger as it grows in age, seems to be against the idea that the tremendous volume of gas issuing from the bowels of the earth can be depended on indefinitely, or even remotely. In fact, some of those who have given much thought to the matter, including, if we mistake not, no less an authority than Dr. Orton, place the longevity of the wells not further off than another decade—a result that, should the estimate eventually prove well-founded, might have been warded off much longer had the most ordinary measures of economy been adopted in the handling and disposition of the product. Will the death of the natural current be accepted as a reason for returning to the unclean and bulky and wasteful heating systems pursued in the natural gas regions near to the coal fields prior to the birth or discovery and application of that current? We incline to the opinion that a negative answer must be returned to the query. When men like McMillin, and scores of others equally bright, ardent, and capable, are bending their minds and energies to the solution of the problem, we fail to see how success can long elude their efforts.

It was not our intention at the outset to refer at such length to the subject, but the question is one fraught with such important possibilities and probabilities as to cause it to take a firm hold on the thought, attention, and interest of our gas makers.

Unluckily, one of the calculations contained in the McMillin paper was incorrectly carried out, and the revision of the mistake causes quite a

difference to appear in the relative value of the components in the fuel gas mixture finally worked out. Our attention was attracted to the error by a correspondent, who forwarded the following:

NATIONAL TRANSIT CO., UNITED PIPE LINE DIVISION,
OIL CITY, PA., Nov. 19, 1887.

To the Editor AMERICAN GAS LIGHT JOURNAL:

In your isssue of Nov. 16 appears a paper on "Fuel Gas," by Emerson McMillin, which I have read with considerable interest. In Table XIII. of that paper I notice what appears to be a serious error in addition, the cost of labor, repairs, and incidentals being given at $2.043 per ton of coal, or 51,600 cu. ft. of mixed gas. It should be $3.043, as will be seen by reference to the figures. This would increase the cost of gas in the holders about 25 per cent., with coal at $2 per ton, and would make the mixed gas cost considerably more than coal gas for equal heating power. I trust, however, that Mr. McMillin will not give up the problem of producing a good and cheap fuel gas, although so far he seems to have failed to do so. Truly yours, EDWIN SQUIRE.

Upon receipt of Mr. Squire's communication we forwarded a copy of the same to Mr. McMillin, in order that a reply thereto might accompany it. Mr. McMillin returned the following answer:

OFFICE OF COLUMBUS GAS LIGHT AND COKE CO.,
COLUMBUS, OHIO, Nov. 28, 1887.

To the Editor AMERICAN GAS LIGHT JOURNAL:—I am in receipt of your communication inclosing letter from Mr. Edwin Squire calling attention to an error of addition in Table XIII of my paper on fuel gas. Mr. Squire is right, and while a correction of the error advances the estimated cost less than two cents per thousand cu. ft., yet that equals a large per cent. of the total. In the preparation of the paper I probably covered two pages of figuring paper for each single page of manuscript produced, and shall be surprised if many errors are not pointed out. I am neither surprised nor disappointed that a correction of the error pointed out should swell the cost per heat unit above the estimated cost of coal gas. In this same connection I called attention in my paper to the fact that the cost was nearly the same. The fact is, we will not be able to make a fuel gas that will be much *cheaper in the holder* than coal gas; and only natural gas can exceed coal gas in quality. However, there are reasons why fuel gas should be made.

First.—The loss by leakage is a much more serious one with coal gas than with a gas costing less per thousand feet; second, the public cannot be induced generally to adopt a high priced gas for fuel; third, in the estimates showing cost of making coal gas credit was given at present prices for residuals, while it is fair to suppose these could not be maintained if coal gas were made in sufficient quantities for fuel; and, finally, in all the estimates of manufacturing and distributing the mixed fuel gas a good, healthy margin was allowed over and above what experience in the manufacture of the gases separately, and recent experiments in the manufacture of the mixed gas, show the gas can be made for.

If the labor expended in the preparation of my paper awakens an interest as shall develop a better and cheaper gas, equally safe and salable, I shall feel amply repaid, and will hail the new system with joy. At present I am inclined to think the system suggested in my paper promises a commercial success, and that is what we are striving for.

Yours truly, EMERSON MCMILLIN.

Candle Power and Castigation.

By B. E. CHOLLAR, Topeka, Kansas.

"Which the same I am free to maintain."—*Bret Harte.*

The extracts in italics are from the paper read by Mr. A. C. Humphreys, M.E., at the late meeting of the American Gas Light Association, and have reference to a paper read by the subscriber at the last meeting of the Western Gas Association. It appears so evident that Mr. Humphreys did not fully comprehend the drift of my paper that I am in a way compelled to reply to his criticism. The purpose of my paper was to show: That the results obtained by the ordinary practice of photometry are, to a considerable extent, delusive and misleading; that they enhance the apparent value of small and intense lights, to the disparagement of those of larger size and lesser brilliancy; that the rule of inverse squares does not hold good with lights of considerable magnitude; that the light from a luminous area diminishes less rapidly than the square of the distance increases; that the energy exerted by a light should be represented by the product of two factors, one of which being increased, the other can be correspondingly reduced; that, irrespective of intensity, the light from a luminous body is independent of distance, and is in direct proportion to its diameter; and, lastly, that the true interpretation of the law should be something like this: The light from a luminous body is inversely as the squares of the distance and directly as its projected area.

Quoting Mr. H.: "*I was surprised to find an intimation in Mr. Chollar's paper that the law was by some supposed to be based upon something outside of mathematics.*" Writers on gas and gas lighting have almost invariably expressed the law in such a way that the casual reader might infer it to be based on some inherent property or quality of the light itself—*e.g.*, "The power of a luminous body to illuminate any defined space is inversely as the square of the distance."—*Clegg.* "Wherefore recourse was had to the well-known law of optics, viz., that light varies inversely as the square of the distance."—*Bowditch.* "Its construction depends upon the well-know law of optics that the quantity of light thrown on an object by a luminous body is inversely as the square of their distances."—*Banister.* "That lights are to each other in the ratio of the squares of their distances."—*Hughes.* "The intensity of illumination is in proportion inversely to the square of the distance of the object from the source of light."—*Hartley.* Hence my illustration was not deemed superfluous.

Mr. Chollar then attempts to prove a new law in the place of our old friend which has stood by us for so many years, to the effect that irrespective of intensity the quantity of light is independent of distance. To say that the intensity of light only decreases with the distance can hardly be construed as an attempt to prove a new law, especially since the assertion is fully supported by the wave theory; for the amplitude of vibration (which produces intensity) decreases with the distance, while the rate of vibration (or wave length) does not.

The second diagram of the article is intended to produce this [the preceding], *but if any of you will study the diagram, and bear in mind that every point of the line emits rays in every direction, you will see that the diagram affords no such proof.* The proof is not in the diagram, for if it were, according to Mr. H., more lines diverging from more points would have had a tendency at least to strengthen it. The diagram referred to was intended to illustrate in a simple way that rays from a luminous body may *converge* at any given point, producing thereat the combined effect of as many luminous points as may be assumed to be contained in the luminous surface. Rays from a point cannot converge and reinforce each other, but must diverge and grow thinner as the distance increases.

Take the case of the opal globe. A certain percentage of the light is cut out, as claimed, but the distribution of light is much better by reason of the enlarged light-giving surface. Exactly so; our case is getting hopeful. The globe, by reason of its greater surface, produces a greater co-operation of converging rays than the naked flame. That is to say, the effect of the converging rays overbalances that of those which diverge or scatter. It is the effect of this concentrating of light energy, so-to-speak, from luminous surfaces that is not estimated by the rule of inverse squares.

I do not think that we shall be following out the proposed line of investigation by going out of our way to attack well-established laws of nature. An attack upon an established law of nature can only result as did the encounter of the bull with the locomotive. Common prudence would admonish one to avoid such a conflict. Preachers may differ among themselves in regard to the interpretation of scripture without becoming liable to the charge of heresy. Lawyers may disagree upon the construction of a statute without being regarded as attacking the law. So also the expression of an opinion in regard to the understanding of a law of nature. Even if the opinion be a trifle on the aggressive order, if supported by substantial evidence, in a respectful way, it ought certainly in a gas convention be tolerated, at least. In the discussion which followed the reading of Mr. H.'s paper, President Morton used the following language:

"Now, suppose that instead of being a point the source of light were a surface. Then, in the first place, it is manifest that the surface may be divided into an infinitude of points, and that what is true of each one of the points must be substantially true of the entire thing." The surface can emit series or systems as it were of converging rays, which continually condense and support each other, while the light from each point in detail must necessarily diverge and become more and more attenuated as the distance increases. Hence, what is true of the surface is not true of each individual point. Later on the President says: " * In fact so that this amplitude or height of wave varies inversely as the square of the distance from its source." Here is a splendid chance for Mr. H. to also charge the President with an assault upon an established law of nature; for if the amplitude decreases with the square of the distance, and the intensity is directly as the square of the amplitude, it follows that the intensity at any given point is inversely as the fourth power of the distance. Again, the President says: "When we say that the candle power is the same we mean, that on testing with the photometer, and allowing the light to fall on a white surface, we get equal illumination of that surface. If it is true in the photometer it cannot be otherwise than true out of the photometer."

The photometer is *based on the assumption that light in general* decreases in proportion to the squares of the distance from its source. To prove a rule with an instrument based on the rule itself is like arguing in a circle.

If, however, a part of the light from a surface decreases less rapidly than in accordance with that law, then what is true in the photometer is not true out of it.

[Reprinted from the London JOURNAL.]

Structural Capacity and Cost of Gas Works.

By V. WYATT.

The address delivered by the President (V. Wyatt) of the North of England Association of Gas Managers, at the 21st half-yearly meeting of that Society, was of the following elaborate and eminently practical nature:

Gentlemen, I thank you for the compliment you have paid me by asking me to preside on the present occasion. In carrying out your wishes I have thought it more profitable for you, and most convenient to myself, that I should confine my remarks to practical points connected with gas works, and not trouble you with platitudes and speculations. I have, therefore, selected the subject of the actual cost of gas works plant, and their capacity or volume to carbonize and bring out the profits of a ton of coals by any company. If we can only control the cost of gas works and plant we can also regulate and economize the selling price of gas. The capital expended requires a fair interest for its outlay; and this interest is an important element in the cost of the gas to the consumer. I have thought recently that some leviathan companies are growing too anxious in upholding high dividends, and have too little thought for the consumer; so that sooner or later every item of cost per 1,000 feet of gas will be severely scrutinized. I anticipate that all large concerns will have to be satisfied, in future creations of capital, with something comparable to the simple 5 per cent. return upon the outlay.

Description of Table.—In the table annexed hereto there are twelve columns giving the capacity and capital cost of the several structures and plant necessary for the manufacture of coal gas for the supply of a town or district, at per ton of coals carbonized, and per 1,000 cubic feet of gas made per diem, in December; and also the capital per ton and per 1,000 cubic feet for the year, reckoned as made up of 200 December average days. The table is compiled for capacity and cost of structures and plant for gas works in a similar form to those tables usually put forth showing the annual cost of gas making. Each ton of coal in the table is, for convenience of calculation, assumed to yield 10,000 cubic feet of gas; but no other data in the table are assumed, but simply deduced from my note-books, experience, and general observation, and are not ideal. I may explain at starting that the capacity of structure in cubic feet is arrived at by taking the *outside* dimensions of the buildings at the ground line, for area, and multiplying the same by the height thereof, from the ground line to half-way up the roof, in feet. These dimensions will give the true cubical contents or capacity of structure *visible* on the works. The foundations are not measured in; but the cost of these is included in the rate per cubic foot given in the schedule. If the foundations were included in the capacity, the quantity would be increased from 10 to 12½ per cent.; but the price per cubic foot would not, therefore, be reduced in the same ratio. The cost of foundations is generally about 5 per cent.

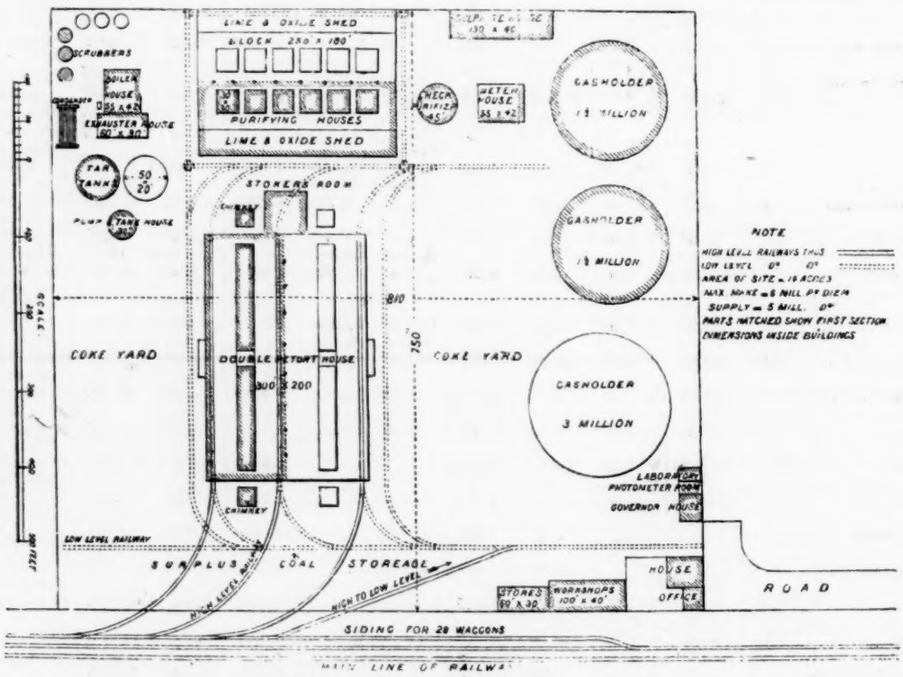
Structural Capacity and Cost of Gas Works and Plant per Ton of Coals Carbonized, and per 1,000 Cubic Feet of Gas Made per Diem in December. Also Capital per Ton and per 1,000 Cubic Feet per Year of 200 December Average Days.

1	2	3	4	5	6	7	8	9	10	11	12
Works, etc.	Capacity of Structure per Ton per Day.	Capacity per 1,000 Cu. Ft. per Day.	Cost per Cu Ft. of Structure C'mplete	Capital per Ton per Day.	Capital per 1,000 Cu. Ft. per Day.	Area per Ton per Day.	Area per 1,000 Cu. Ft. per Day.	Capital per Ton per Year.	Capital per 1,000 Cu. Ft. per Year.	Ratios to Total Capital.	Remarks.
	Cu. Ft.	Cu. Ft.	s. d.	£	£	Sup. Ft.	Sup. Ft.	£	£		
Land				4.33	0.433	163.00	16.000	0.0216	0.0022	0.0077	2½ acres of land per mill. gas per diem.; £200 per acre.
Drains, boundary walls, etc.				4.06	0.406			0.0203	0.0020	0.0072	£188 per acre of site.
Retort house, coal stores, and retort ovens	6,000	600.00	0 4.00	100.00	10.000	Floor 100.00	Floor 10.000	0.5000	0.0500	0.1764	Carbonizing portion, 60: coal and coke stores, 40 per ct.; 1 ft. lineal of retort house per ton per diem.; stage house, 1 ft. lineal costs £100.
Condenser	33	3.30	2 7.50	4.33	0.433	Surface 50.00	Surface 5.000	0.0216	0.0022	0.0077	5 to 8 minutes contact, max. and av., 1s. 9d. per superficial ft. of area.
Boiler house and plant within.	120	12.00	0 11.00	5.67	0.567	Floor 3.85	Floor 0.385	0.0283	0.0028	0.0100	House 18, and boilers and plant 82 per cent. of cost.
Exhauster house and do.	105	10.50	1 2.00	6.02	0.602	3.00	0.300	0.0301	0.0030	0.0106	House 25, and exhausters 75 per cent. of cost.
Scrubbers and washers	100	10.00	1 8.00	8.33	0.833	Sieves 10.00	Sieves 1.000	0.0416	0.0041	0.0147	12½ per cent. of scrubbers can be used as washers, 15 to 27 minutes contact, max. and av.
Purifying house	1,620	162.00	0 1.50	9.58	0.958	50.00	5.000	0.0479	0.0048	0.0171	
Purifiers	133	13.30	3 2.00	20.00	2.000	Sieves 100.00	Sieves 10.000	0.1000	0.0100	0.0353	4.00s. per sup. ft. sieve area; 15 to 27 minutes contact.
Lime and oxide sheds	810	81.00	0 1.50	4.79	0.479	25.00	2.500	0.0240	0.0024	0.0084	Half area of purifying house.
Meter house and do.	174	17.40	0 7.00	5.30	0.530	3.85	0.385	0.0265	0.0026	0.0093	House 45, and meters 55 per cent. of cost.
Gasholder tanks	5,000	500.00	0 2.33	48.00	4.800			0.2400	0.0240	0.0847	Sm. tanks cost £5–£6 per 1,000 st'rge.
											Large do. " £4 £5 " "
Gasholders	10,000	1000.00	0 1.50	58.15	5.815			0.2907	0.0291	0.1026	Sm. hldrs. " £6–£7 " "
											Large do. " £5–£6 " "
Mains and valves on works				8.33	0.833			0.0416	0.0042	0.0147	
Railway communications				10.00	1.000			0.0500	0.0050	0.0177	5 lineal yds. railway per ton per diem, maximum.
Tar and liquor tanks	136	13.60	0 7.25	4.15	0.415			0.0207	0.0021	0.0073	£5 per 1,000 gallons of storage.
Workshops and offices	1,500	150.00	0 4.00	6.16	0.616			0.0308	0.0031	0.0109	
Tools and implements on works				8.75	0.875			0.0437	0.0044	0.0154	
Street mains and town distribution plant				162.32	16.232			0.8116	0.0812	0.2857	50 per cent. of previous items.
Engineer'g, sup'vis'n of works, law and parliament'y charges				36.46	3.646			0.1823	0.0182	0.0643	7½ " " "
Floating capital, stores, etc.				52.35	5.235			0.2617	0.0261	0.0923	10 " " "
Total				567.08	56.708			2.8350	0.2835	1.0000	
Margin for w'rks under repair & increased consump. = 25 p. ct.				141.77	14.177			0.7087	0.0708		
Safe total				708.85	70.885			3.5437	0.3543		

only of the total value of the structure. With these data you can either cube in the foundations or leave them out, as I have done, and estimate accordingly. The dimensions of the several iron vessels used on the works for purification, storage, etc., for capacity, are taken inside and with net measurement; but the cost per cubic foot includes the pipes, valves, connections and foundations immediately surrounding and in contact with them. The brick tanks constructed upon the works for storing tar and liquor, and also those to contain the gasholders, are likewise measured net *inside* the walls. No. 1 column in the table describes the character of the works and plant, including the several items of expenditure necessary for the full equipment of a gas undertaking. No. 2 column gives the capacity or volume of structure in cubic feet required per ton of coals carbonized per diem in the month of December. No. 3 column shows the capacity or volume of structure per 1,000 cubic feet of gas made per diem. No. 4 column gives the cost of structure at per cubic foot, measured as previously described. No. 5 column shows the capital expenditure for carbonizing each ton of coal per diem, in pounds sterling and decimals of a pound. No. 6 column gives the capital per 1,000 cubic feet of gas made per diem in pounds and decimals. No. 7 column shows the areas of land, floor surface, or sieves, in superficial feet and decimals per ton of coal per diem. No. 8 column gives the corresponding areas

Drainage, etc.—The items of "Drains, boundary walls, etc.," are put down in the schedule at the rate of £188 per acre of site—a price deduced from experience.

Retort House.—In the item of "Retort House, coal stores, and retort ovens" complete, a stage type of retort house is contemplated; containing within itself, in addition to the room for carbonizing, sufficient floor area to stock coal equal to three weeks' average consumption, which should be ample in these days of railways to insure constant and fresh supplies. If a greater stock of coal be required at any time of trouble or difficulty—such as anticipated strikes, or an abnormal rise in price—it is possible to store a surplus in the open for a time, under the high level viaduct, at the point marked on the sketch plan attached. There are 6,000 cubic feet of house capacity required per ton of coals carbonized per diem, at a cost of 4d. per cubic foot, all provided, being £100 per ton carbonized, and £10 per 1,000 feet of gas made per diem; with a floor area inside the walls of 100 superficial feet per ton, and 10 superficial feet per 1,000 cubic feet per diem, and a capital of 10s. per ton per year of 200 December days, and 1s. per 1,000 cubic feet. The cost per superficial foot of floor area is £1 for the house complete and fully equipped with carbonizing plant. Supposing a floor retort house were adopted—that is to say, one without stages and special coke holes—then this can be built



Sketch Plan of Gas Works.

per 1,000 cubic feet of gas made per diem. No. 9 column shows the capital expenditure per ton of coal carbonized per year of 200 average December days, in pounds and decimals. No. 10 column gives the capital per 1,000 cubic feet made per year. No. 11 column shows the ratio of cost which each item of expenditure bears to the total capital of the undertaking. No. 12 column is for the remarks and explanations to the several items, giving such information as cannot be conveniently brought into the previous columns.

Land.—The first item of expenditure in the list is for land. The quantity taken is at the rate of 2½ acres for every 100 tons of coal carbonized, and each million cubic feet of gas made per December day; and it is rated at £200 per acre. Get three acres per million cubic feet per diem if possible; and also have regard to the ultimate wants of the district, to avoid difficulties in the near future. This item of the capital is the most uncertain for valuation, and depends upon position or contiguity of the works to the population, and "land sharks." Anything from £100 to £1,000 per acre may be screwed out of a gas company if it be so imprudent as to locate its establishment within even smelling distance of a large aggregate of human noses. A good rule to follow for the location of new works is, when the land is fetching more than £200 per acre near a proposed site, to get further away, and spend something extra on the leading mains from the works, as cast iron is cheap nowadays, and distance from a town is frequently an advantage, if not "an enchantment to the view."

at a cost 25 per cent. less than for a stage house. But (and here comes the pinch) you cannot then work economically and expeditiously in the carbonizing department—the waste of coke and amount of breeze produced is greater, and the labor is muddled and crossed, do what you will. The stage house has its own coke as well as coal stores; and these are great features of economy and comfort in working. The table gives one foot lineal of complete retort house to each ton of coal carbonized per day, and this foot costs £100, and yields gas enough for 500 people for a December day. There are, however, exceptional days in December and January when the demand in manufacturing districts reaches 50 per cent. more than this, which has to be met with by an excess of gas storage capacity upon the works. The retort house complete runs away with 18 per cent. of the total capital. The retort house shown on the sketch plan is a double or twin one, or rather two houses parallel with each other, united by a central line of columns, and where one line of high level and one of low level railway does double duty through the center line of the houses. You can, of course, have the single and isolated lines of retort houses, with the extension placed end on, instead of being twinned together. This plan is the superior of the two for ventilation and comfortable working; but it is slightly more expensive than the coupled houses. The cost of the retort house and coal stores combined, *exclusive* of retort ovens and fittings, is about 3d. per cubic foot.

Condenser.—The item "Condenser" in the table shows 33 cubic feet of capacity and 50 superficial feet of surface to the apparatus, and a capital

of £4.33 per ton of coal carbonized per diem, with a contact time for the passing gas of 5 to 8 minutes, maximum and average makes. Sometimes 50, and even (on the Continent) 100 per cent. more than this provision is allowed; but such happens where the condensers are formed of thick cast iron pipes, and not with thin wrought iron sheet tubes. With Newcastle coal the smaller proportion is sufficient; but with Midland and some other coals which throw down more tar and liquor, more area of condensation is necessary. It is important to keep in view the fact that the efficiency of the condenser is in proportion to the time of contact, and the capacity or volume of structure to bring about this time—in other words, to secure the slowest possible speed to the gas current, consistent with a reasonable outlay. A condenser built up of large tubes 2 feet diameter, having the same external surface, and the same weight of iron as one that is constituted of small tubes of 6 inches diameter, gives four times longer contact, and costs less money to erect. This is simply owing to the greater internal capacity of the larger tubes, in the proportion of over 4:1, with the same expenditure of material. Here volume of structure and time comes in, and tells in efficiency, as we shall see further on; forming an important factor in the various stages of gas manufacture. To effect important changes, nature demands time and repose; and so do the feeble efforts of man require the like to induce perfection and success. The gas, however, in traversing the larger tubes, is not so much *frictionized*, or tortured, as with the smaller ones; but this valuable quality we can compensate for by introducing intercepting screens in the interior of the inlet tubes or corner pilasters of a built-up condenser, and so cut up the current of gas into minute jets or streams. The cost of a condenser, formed with the larger tubes of thin wrought iron $\frac{3}{16}$-inch thick, is about 1s. 9d. per superficial foot of condensing surface, at present prices. The annular form of condenser does not radiate off the same amount of heat from the gas in a given time as does the simple straight horizontal tubular condenser, metal for metal, and cost for cost. Sometimes there is placed on the works to take the current of gas after passing the exhausters an additional condenser, cooled with water, with about half the cubic capacity of the air condenser, which can be readily thrown into and out of use, according to the season of year, to temper the gas previous to entering the scrubbers, and to correct any increase of warmth given to the gas by the speed of the exhauster. In fact this water condenser is the *check* vessel of purification at this point of manufacture.

Boiler House.—The item of "Boiler house and plant within same," shows 120 cubic feet of structure or building to house the boilers and details, with a capital of £5.67, and a floor area of house equal to 3.85 superficial feet per ton per diem. The cubical contents of the boilers (outside net measurement) should be not less than 5 cubic feet per ton per diem, of the double-flued type of boiler. Of the total expenditure for this item the house and chimney represent 18 per cent., and the boilers, settings and connections 82 per cent.

Exhauster House.—The item of "Exhauster house and plant within" gives 105 cubic feet of building structure to house in the exhausters, engines and connections, with a capital of £6.02, and a floor area of 3 superficial feet per ton per diem. Of the total expenditure the house represents 25 per cent., and the exhausters, engines, etc., 75 per cent.

Scrubbers.—The item "Scrubbers and washers" shows 100 cubic feet of internal capacity of vessels, and a capital of £8.33 per ton per diem, with a gas contact of from 15 to 27 minutes, maximum and average makes. This is an ample provision of scrubbing power; and 12½ to 15 per cent. of this volume can be used and adapted as a washer by simply introducing into the bottom of the scrubber a washing compartment, to intercept the tarry matters and other impurities from the foul gas as it enters each vessel. Some engineers think that 75 cubic feet per ton per diem is sufficient—that is to say, they use two scrubbers in the line of gas current instead of three, with a washer as an adjunct. Where, however, three scrubbers are employed the last one can be operated as a *check* scrubber, for the purpose of taking out the last traces of ammonia from the gas before advancing to the purifiers; and also to take in the regulated quantity of cold water to insure good scrubbing, as well as to govern the temperature of the gas below 60° F. in summer, and over 40° F. in winter. The volume of gas contained in the scrubbers at one time amounts to about 1 per cent. of the maximum make per diem, to give the requisite contact time. The horizontal net sectional area of all the scrubbers is equal to 2 superficial feet per ton per diem on the maximum make. About one-fourth, or 14 pounds, of the total impurities in the foul gas—such as ammonia, carbonic acid, sulphuretted hydrogen, and sulphur compounds—in all about 56 pounds (or ¼ cwt.) per ton of Newcastle coal, are intercepted by the scrubbers; and they, therefore, become valuable as general purifiers of the gas, in addition to their special duty as ammonia abstractors, when judiciously worked. Ample volume in this branch of gas manufacture irrespective of mere scrubbing material, is as important as with the other sections; and capacity tells in efficiency. However, the chief duty to be looked for from the scrubbers is the production from a ton of Newcastle coal of not less than 25 gallons of 10-ounce liquor and 22 pounds of sulphate. Square and six-sided (hexagonal) scrubbers can be conveniently used sometimes, grouped in line or in clusters, isolated, or even united together as twins or triplets, to effect economy of material, space and cost.

Purifying House.—The item of "Purifying house" shows 1,620 cubic feet of building structure to cover in and house the purifiers from the weather, with a capital of £9.58, and a floor area of 50 superficial feet per ton per diem. The possession of a purifying house upon the gas works is deemed by some officials as a luxury that should be ignored; and consequently in many large works it is dispensed with, and this item of capital saved. In such an event, the purifier covers are upheld by catches during the time of changing the purifying material, as a temporary roof. The purifying house is, however, one of the least expensive buildings upon the works; costing only 1½d. per cubic foot of structure.

Purifiers.—The item of "Purifiers" gives 133 cubic feet total of vessels, internal capacity; and a capital of £20 per ton per diem, with a gas contact for the whole range of purifiers of from 15 to 27 minutes, maximum and average makes. The sieve area enclosed in the boxes is equal to 100 superficial feet per ton per diem. Taking the top area on the plan or horizontal section of one of the purifiers in a series, the allowance of 3 superficial feet of area per ton per diem is sufficient. The price of 3s. 2d. per cubic foot of box or structure includes the sieves, valves, pipes, and other details inside the house to operate the system. Taking sieve area only as a basis of cost, the value of a set of purifiers can be arrived at by pricing them out at about 4s. per superficial foot. The capacity of the purifying material is about one-third that of the box. In some gas works where the sulphur compounds, other than sulphuretted hydrogen, must be in great measure eliminated, as much as 150 cubic feet of boxes per ton per diem is provided. In the most advanced works the gas current passes through a group of from six to eight purifiers, and filters through a total thickness of from 15 to 20 feet of lime and oxide, and is allowed a time of contact of from 17 to 30 minutes. Any number of purifiers in a series are used by gas companies, varying from four to eight. The number of boxes employed is an index of how far the sulphur has been removed from the gas, and how many grains per 100 feet of gas are going to the consumer, ranging from 5 to 50, as well as from 0 to 3 per cent. of carbonic acid, which latter means about one-eighth of the light. No reasonable expense should be spared in the purification of the gas; and the time should have passed when gas is sold containing more than 10 grains of sulphur in each 100 cubic feet. We hear of the sulphur occasionally in some large districts reaching to over 40 grains, and the carbonic acid to nearly 3 per cent. Some people, including analysts, say that this does not pollute the air of dwellings; but they should be ashamed of this, and only whisper it to the marines.

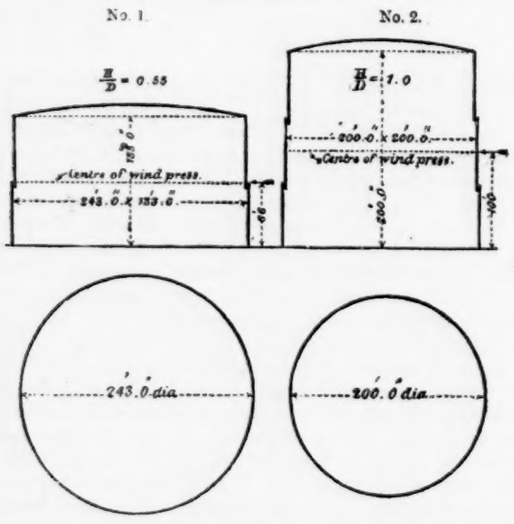
Lime and Oxide Sheds.—The item of "Lime and oxide sheds" shows 810 cubic feet of building structure for covering in, storing and preparing the lime and oxide for service in the purifiers, with a capital of £4 79, and a floor area of 25 superficial feet per ton per diem. The total area of the lime and oxide sheds is one half that of the purifying house proper, which they adjoin, and is sufficient for all the purposes of lime preparation and oxide revivification.

Meter House.—The item of "Meter house and plant" contained in it shows 174 cubic feet of building structure to house in the station meters, with a capital of £5.30, and a floor area of 3.85 superficial feet per ton per diem. Of the total expenditure the house represents 45 per cent., and the station meters and connections 55 per cent.

Gasholder Tanks.—The item of "Gasholder Tanks" gives 5,000 cubic feet of structure, measured inside the walls, with a capital of £48 per ton per diem. The cost in the schedule is given at 2½d. per cubic foot of capacity; but if the tanks were of the largest type they could be constructed at 2d. per cubic foot. The larger the tank the cheaper the rate of the unit. Thus small tanks under 150 feet diameter cost from £50 to £60 per ton per day, equal to from £5 to £6 per 1,000 cubic feet of storage of the gasholder; while large tanks of 150 to 200 feet diameter cost from £40 to £50 per ton per diem, equal to from £4 to £5 per 1,000 feet of storage, according to the difficulties met with in construction. Brick tanks are to be preferred as a rule, built and flushed up solidly at every joint with Portland cement mortar, unless the locality presents most favorable materials for a concrete tank, which can be constructed reliably if a free use of hoop iron be used to prevent cracks and bind the whole together. I hope, from details I have prepared, in the future to build tanks in concrete sections, veneered with a skin face of brickwork in cement, dis-

pensing with heavy timbering in the trenches, at one-half the cost of the gasholder and framing, instead of about five-sixths, as at present.

Gasholders.—The item of "Gasholders" shows 10,000 cubic feet of capacity, or available gas storage, with a capital of £58.15 per ton per diem, and a cost of structure of 1½d. per cubic foot. In large and small holders there are generally about 20 pounds weight of wrought iron used per superficial foot net of sheeting plates to the side and crown, inclusive of the external framing for guiding the gasholder. Of this about 12 pounds is due to the holder proper, and 8 pounds to the framing. This is assuming that a wrought iron and not a cast iron framing be used; and as cast iron is an unreliable and brittle material, it is to be hoped it will die out in its application to holders. The total weight of wrought iron in a gasholder and framing complete is from 6½ cwt. (¼ ton) for the larger sizes, to about 8 cwt. for the smaller, per 1,000 cubic feet of available storage. But the weights of wrought iron used per superficial foot of skin for the majority of holders should not vary much from the standard given, as the chief item of iron work is the sheeting, and this for both large and small holders is alike—viz., ⅛-inch thick. It is volume which cheapens the rate per cubic foot of gasholders. The leviathan gasholders with their framing have been constructed complete with ¼ ton of wrought iron per thousand cubic feet of storage; but I fear the factor of safety in such examples under a 56 pounds wind pressure, is short of 4:1—the universal factor recognized in iron structures both by the Board of Trade and practical engineers. Some gasholders, I know, have a doubtful factor of safety of 2. The cost of a gasholder and framing—all ironwork—per superficial foot of skin (side and crown) is about 3s. for a gasholder containing 2 million cubic feet, and £5 5s. per 1,000 cubic feet, *available* storage; and with tank, all complete ready for storage, 5s. 4d. per superficial foot of sheeting at current prices. The cost of the gasholder and tank combined may be estimated for moderate-sized holders at £10 per 1,000 cubic feet of storage—that is to say, a holder and tank for 2 million storage will cost £20,000, which is easy to remember. The 1 million cubic feet holder and tank may cost £12 per 1,000 feet (holder, £6 10s., tank, £5 10s.); for it must be remembered that the sheeting or skin surface of a 1 million feet holder is only two-thirds that of a two-million feet one. The storage in the table is taken for an average day's make in December; but in manufacturing towns this should be increased 50 per cent.—say, 1½ days' make—otherwise the carbonizing power of the works must be increased. Efficient carbonization can only be effected by full storage. Tanks and gasholders form an important element in the total capital amounting to nearly 20 per cent.



Capacity	6½ million cu. ft.
Area of skin (side and crown)	147,612 sup. ft.
Vertical sectional area	32,319 sup. ft.
Stability, 32,319 × 66 = 2,133,054.	
Tank cost 24 per cent. more than No. 2.	
Land cost 33 per cent. more than No. 2.	
Area of base	46,058 sup. ft. = 68 p. ct. more than No. 2.

Capacity.....	6½ million cu. ft.
Area of skin (7 per ct. more than No. 1)...	156,800 sup. ft.
Vertical sectional area = 24 per cent. more than No. 1.	40,000 sup. ft.
Wind leverage = 50% more than No 1 and nearly twice the strength of framing.	
Stability, 40,000 × 100 = 4,000,000.	
Area of base	31,200 sup. ft.
Excess of cost for tank and holder, 12½%.	

	H.	D.
A good proportion is	$\frac{H}{D} = 0.50 = \frac{1}{2}$	to 1.
A better is.....	$\frac{H}{D} = 0.66 = \frac{2}{3}$	to 1.
Many holders are.....	$\frac{H}{D} = 0.33 = \frac{1}{3}$	to 1.

A few words as to the construction of tanks and gasholders. Supposing we take the example of a large holder with a capacity of 5 or 6 millions cubic feet, and work out its proportions, figures and strains carefully, at the same time throwing aside all opinions and authorities, and apply the results to the two systems of construction—viz., with two lifts, and with three lifts. In the first place the tank for the two-lift holder will cost only about 20 per cent. more than that for a three-lift one; but the wrought iron guide framing of the three-lift holder will require to be nearly twice the strength of the framing to the two-lift, which I will explain by diagrams of the two erections. (See diagrams Nos. 1 and 2). There is 50 per cent. more leverage to take hold of the wind pressure in the three lifts; and the strength of structure to meet this must be carried throughout the greater height of framing, and into all its details. The net result of all the calculations for the two structures would be that the three-lift holder costs, when all things are fairly priced out, at least 12½ per cent. more than the two-lift example of the same volume. I am here assuming Board of Trade rules for the iron scantlings and wind pressure, a factor of safety of 4, and an extreme gale force of ½ cwt. per superficial foot of vertical section to holder. Some people do not believe, or I should rather say will not believe in such a storm; but, for all that, nature does, and we generally have to follow her instead of the few, and to her we must submit. Recollect also (and this I have not taken into account) that "the wind bloweth where it listeth," and blows stronger at a height of 100 feet than it does at 66 feet—a fact which all sailors know who go up the rigging of ships, and so do workmen who repair chimneys. The wind gauges also declare this. Going up into the air with structures conduces to neither economy of material nor to facile building. The area of sheeting plates, or skin, for gasholders is greater for three than for two lifts; and this is the item of cost, do what we will, which runs away with the money—for, taking the floating weight of a holder by itself, the sheeting alone amounts to more than one-half of the entire weight. Also the three lifts have more complication in their construction, a greater number of parts, 50 per cent. more rollers and carriages to look after and grease, and be troubled with, a cranky, knock-kneed middle lift, with imperfect posts and stiffeners, as there is not room enough in the construction to get in the requisite muscle, and how are you to approach the spaces between the lifts to do the repairs? I note from an old edition of the "Encyclopædia Britannica," published more than 30 years ago, an illustration of the three-lift holder, with the open-webbed standards or guides, which we all pride ourselves as being so modern and original, and everybody says he invented; but they are of cast and not of wrought iron. We also recollect the original of this at the old City of London Gas Works, now defunct, and which I helped to pull down about 20 years ago, and send out of the country forever. Just another word or two about stiffening or trussing the crown of a holder, in opposition to the bladder-topped form. The trussed crown renders the structure self-contained for either storage purposes, under a gale, or when under repair, without inflation. The amount of wrought iron required for this special duty is only 6 per cent. of the total weight of framing and holder proper. The temporary crude props and wooden framing now used in some tanks to support the flabby sheeting of the crown when the holder is on its bearings in the tank, cost, when only decently performed, 12½ per cent. of the total value of the complete holder and framing. Also in dispensing with the crown stiffening, the top curb and crown sheeting must be strengthened. Only imagine a large railway station roof supported throughout its area by a network of wooden props and framing because it was so very convenient and cheap!

Mains and Valves on Works.—The item "Mains and valves on works" gives a capital of £8.33 per ton per diem. The pipes used about the gas factory are generally too small for the sudden accumulations of naphthaline and tarry matters which take place in them at times. The sectional area of the main to each independent section of the manufacture should not have a less sectional area of gas-way than 150 superficial inches per million cubic feet maximum gas make, or 1½ superficial inches per ton of coals carbonized per diem. In the arrangement of these mains, at points of intersection, it is better to provide roomy cross-over chests, instead of flattening the pipes, and "ducking" one under the other.

Railway Communications.—The item of "Railway communications" and rails to transport on to the works in detail from the main line of railway all the necessary materials used in the manufacture of gas—such as coals, lime, oxide, building materials, etc.—and to form an exit for coke, breeze, tar, sulphate, and other products—shows a capital of £10 per ton per diem. The importance of this item will be fully realized by noting the arrangement on the plan annexed hereto for works with a

yield of 5 millions cubic feet of gas per diem. The high-level viaducts leading from the main line of railway, external to the works, to carry the coals direct into the retort house without trans-shipment have each a single line of railway, and average 8 yards in height and 4½ yards broad at the rail level. With cast iron columns, wrought iron superstructure, and permanent way complete, of a substantial character, the cost is about £15 per lineal yard, including foundations. If the outside dimensions of the structure be cubed up the cost will be about 4d. per cubic foot. Taking the high and low level lines together on a fairly large establishment, there are necessary, to do the day's work with expedition and comfort, 5 lineal yards of railway per ton of coals per diem; or 500 lineal yards per million feet of gas made per diem. The low-level lines need not cost more than 15s. per lineal yard complete, including steel rails 56 lbs. (½ cwt.) to each yard of rail, equal to 1 cwt. for a pair of rails, sleepers, and ballast. The gauge of the lines should be the almost universal gauge (conventional though it be) of 4 ft. 8½ in. between the rails, excepting for the sharp curves upon the works, where the clearance should be 4 ft. 9 in. The proportion of high level to low-level lines on the works may be taken at about one-third.

Tar and Liquor Tanks.—The item of "Tar and liquor tanks" shows 136 cubic feet of structure, measured inside the walls, with a capital of £4.15 per ton, per diem. The cost in the schedule is 7½d. per cubic foot of capacity—about three times that of a gasholder tank; and about £5 per 1,000 gallons storage. There are provided 850 gallons of storage per ton, per diem; but this quantity may be usefully extended to 1,000 gallons for the same duty.

Workshops, Offices, etc.—The item of "Workshops and offices" gives 1,500 cubic feet of structure, with a capital of £6.16 per ton, per diem, and at a cost of 4d. per cubic foot. A dwelling house is included in this item.

Tools, etc., on Works.—The items of "Tools and implements on works" are set down at a cost of £8.75 per ton per diem.

Street Mains and Distribution Plant.—The item of "Street mains and town distribution plant" shows a capital of £162.32 per ton per diem, being about 30 per cent. of the total expenditure on the entire undertaking. This item is a large one, and comprises all the works in the town and district after the gas mains have left the works proper. If we take a weight of about 1 cwt. of cast iron pipes per head of the population to be supplied, it will be sufficient for the canalization (as the French call it) or piping of a town, where the mains and services are judiciously laid down, and not, as they were in the early days of gas lighting, in haphazard fashion, where 33 per cent. of the pipes are old metal, and not earning money. The weight of piping in some districts reaches as high as 1½ cwt. per head of the population. There are towns in which it would be good policy to take up in sections the whole of the street mains, and relay them on good lines and proportions, and so save leakage; bringing the latter down to something approaching 5 per cent. of the make, and not, as in some towns, from 16 to 18 per cent. The leading mains from the works to the margins of district should have a sectional area of not less than 175 square inches of pipe section per million cubic feet per diem, so as to run the day's make of gas into the heart of the district in 4½ hours' time. At least 33 miles of street mains should be provided per million cubic feet of make per diem, or ⅛ mile per ton per diem, of an average diameter of from 5 inches to 6 inches; and, approximately, from 25 to 30 tons of cast iron pipes for the same duty. Each mile of main should supply a population of 1,500 persons, and distribute the yield of gas from 600 tons of coal per year. Some manufacturing towns at the present time exceed this by about 20 per cent.; the average, however, is about 400 tons of coal carbonized per year to each mile of main. The number of consumers per mile of main may be assumed at 150, one meter to each ten of the population, and the day's make in December at 20 cubic feet per head. On extraordinarily dark days the consumption figure may run up in dense districts to 30 feet per head of the population; but on these days the storage is heavily drawn upon, and so equalizes the December make. Hence the necessity for a storage in some towns equal to 1½ days' make of the same month. The leakage in gas mains can be largely reduced by the gas company doing its own main and service laying and repairs, and not by contract, in the same way as the railway company does with its permanent way. The gas pipes are the carriers of the staple article—gas—sent forth by the gas company, and must be as perfect as possible in their joints and details. The leakage of gas, alone in London, in one year, would nearly supply Newcastle-on-Tyne. The public lamps should be liberally supplied, and the cocks and governors kept free from naphthaline and carbon clogs; allowance and compensation being made in the delivery to each lamp for accidental stoppages, and so please our customers—the public—instead of creating the impression abroad that they are being "done." The gas flames in some towns, and even in the Metropolis, are very sickly-looking and split up at some seasons of the year, and this goes on for weeks together. The consumers' meters and the services to them should be free, and throw in some economical and light-saving burners; so that all the customers may exactly know what they are to pay per 1,000 cubic feet for the gas consumed. Wipe out the extras from gas accounts, as they suggest the grasp of monopoly. These concessions will sweep away much of the petroleum and oil lighting, which is now so extensively used in the manufacturing towns and the Metropolis. In London only half the total number of houses are supplied with gas; and there are enormous stores of petroleum in the Metropolis to supply artificial light, which should be superseded by well purified and cheap coal gas. Do not give so much attention to the payment of dividends of over 12 per cent. We may get up some fine morning and find that some impatient man, with a restless intellect, has conceived a practical scheme for turning into cheap light the vast stores of petroleum existing in the world, which may yield, from the crude oil, 30 to 70 per cent. of illuminating or kerosene oil. The supply appears to be unlimited. One new field is described as "having an area of hundreds of square miles saturated with petroleum and asphalt, which flows in streams through dense forests, and emits inflammable gas, bursting into flame sheets, like the Caspian region, which latter dates from thousands of years ago." Tank-ships to carry this oil can be propelled on the high seas by a motor whose power may come from its own floating cargo; and the freight charges may be nominal. *Cave* petroleum. Refined, good burning petroleum is now talked of at 3½d. per gallon. We must not frighten ourselves further on this subject, but make up our minds to produce cheap gas, and go on to the next item.

Engineering and Parliamentary Charges.—The item of "Engineering supervision of works and parliamentary charges" gives a capital of £36.46 per ton per diem; being about 7½ per cent. on the capital. This charge is a somewhat elastic one, and depends much upon the pugnacity of the population one has to do with, as well as the conscience of the engineer.

Floating Capital.—The item of "Floating capital, stores, etc.," shows a capital of £52.35 per ton per diem. This charge can be kept under by good business arrangements, and looking up sharply the quarterly accounts of the consumers.

Margin for Safe Working.—The total capital per ton per diem of all the preceding items amounts to £567.08 per ton of coals carbonized per diem, which equals £56.708 per 1,000 cubic feet per diem; per ton per year, £2.835; and per 1,000 feet per year, £0.2835. But then for the safe working of the undertaking, and to allow for works under repair, and increased consumption pending further extensions of the works, I have added at the bottom of the table 25 per cent. to produce what I call a safe total expenditure. The items include sound structural works—something better than "lath and plaster." We therefore arrive at a capital of £708.85 per ton per diem, and £3.5437 per ton per year, which should be ample to fit out and equip a gas undertaking to carry on a profitable business. You will please note this fact, that many of the larger gas companies in the land are only earning money from actual works which represent about 66 per cent. of their reputed capital. The other 33 per cent. ought to have been wiped out, and written off their accounts long since, and should be considered as used up, senile, affected by *anno domini*, or non-existent. They have only from £3 to £4 of value in useful constructions to show for their money per ton per year—something like the "reputed" pint bottles of beer when compared with "imperial" pints.

Percentage of Cost of Works.—Taking the capital as a whole, the percentage expended on carbonizing plant is about 18; mechanical plant and buildings for same (boilers, exhausters, and meters), 3; purifying plant and buildings, 8; gas storage, 20; distribution, 30; and sundries, 21—total, 100.

Cost of Buildings and Plant by Floor Areas.—The cost of the several buildings used about gas works may be readily estimated by taking the areas of useful or available floors, inside the structures, in superficial feet, and with these divide the cost of house and plant. Thus, for the retort house, coal stores, and plant inside, £1, boiler house and plant £1.51, exhauster house and plant £2, station meter house and plant £1.38, purifying house and plant £0.59, and oxide and lime sheds £0.19 per superficial foot of floor space, will be found sufficient to cover the cost.

Prices for Valuation Schedule.—The following are the several prices for works and materials, provided and fixed in the structures complete, which have been adopted in arriving at the cost per cubic foot of structure in the table annexed hereto: Land, £200 per acre; excavations for foundations in buildings at 10d., and for tanks at 2s. 6d. per cubic yard;

Portland cement concrete, 10s. 6d. per cubic yard; ordinary brickwoak in mortar, 21s. per cubic yard; the same in cement, 26s.; brickwork of a mixed character, common and firework 30s. per cubic yard; ashlar stone, 4s. per cubic foot; firestone, 5s. per cubic foot; deal timber, 2s. 6d. per cubic foot; oak, 5s. 6d. per cubic foot; square of Duchess slating (10 ft. by 10 ft.), 30s.; and special brick paving, with 6 inches thick of concrete, to floors, 5s. 6d. per superficial yard. A bench of ovens cubed up from outside dimensions above the floor line, costs 2s. per cubic foot, including arches, retorts, and fittings complete; cast iron in stage plates, columns, and other forms, from £5 10s. to £10, with an average of £8 per ton; wrought iron, at an average of £16 per ton; and steel rails, £8 per ton. The cost of main laying complete, all materials and labor included, may be taken at £7 per ton of cast iron, and embracing all trench work. By a comparison of these rates with local charges for the same works, a percentage of variation can be deduced which may be added to or deducted from the estimates per cubic foot of structure given in the schedule attached, without going into much detail, and the true local value of the works arrived at and estimated.

Works Built in Two Sections.—If the complete plan of the new works or extensions be arranged for building in two sections, at two different periods, to suit a gradual outlay of capital, then, supposing the works when wholly finished to cost £3.54 per ton per year (as in the table annexed), then the first section will cost 66 per cent. of the ultimate cost of works; and until the completion of the scheme the capital cost per ton of coal carbonized per year will be at the rate of £4.72. This arises from the special arrangements of works which contemplate doubling the make at an early period of time, and which have about them many works performed on account of future operations.

Estimates.—The valuations which I here give in the schedule are made upon the assumption that the new gas works or extensions will be of a magnitude equal to that shown on the plan attached hereto, and which is capable of supplying, with certainty and safety, 5 million cubic feet of gas, and carbonizing 500 tons of coal per diem. I present the ideal plan with the paper to explain the arrangement of gas works generally, and not with a view to its being the only perfect arrangement for gas works. Some other plans would do as well to work out the factors of this address. You can take the plan "with a grain of salt" added from your own experiences, to make it suit individual fancies and predilections. Supposing the works to be carried out were of smaller caliber than the one before us, then, to arrive at their cost, I should merely add 2½ per cent. to the values given for every million cubic feet, or 100 tons of coal carbonized per diem, that they are less in gas power than the example furnished. In the arrangement of their gas works some engineers may like to play upon round figures, and would prefer for the several details multiples of the figures 5 and 10, thus: Retort house, 500; condenser, 5; scrubbers, 10; boiler and exhauster houses, 10 each; meter house, 20; purifying house and lime and oxide sheds, 250; purifiers, 10 to 15; gasholder tanks, 500; gasholders, 1,000; tar and liquor tanks, 10 to 15; and workshops and offices, 150. They would then take the cubic feet of structural internal capacity per 1,000 cubic feet per diem of gas made in December, and, pricing out these at their respective rates, get the value of the works. This suits well for parliamentary purposes, and is fairly correct.

Position of Works.—The gas works, if possible, should be situated well away from the center of population, wherever a new site is necessary; and they should be in railway touch of the outside world and collieries, so as to avoid any necessity for excessive storage of coal in the retort house, with its consequent deterioration, beyond the 14 December days, or 21 days' average consumption. Cast iron pipes are cheap enough at the present time, and any convenient pressure up to about 18 inches can be insured on a long leading main from the works to the heart of a district by means of an auxiliary exhauster at the outlet of the gasholders. The loss of illuminating power in the gas from long runs in mains may be disregarded where there is a good volume of gas delivered daily. It only amounts to 1-20th of a candle for each mile of pipe. With large volumes of gas and large pipes well under the ground, this almost disappears, and the light is less wasted than with the system of daily storage in a gasholder exposed to all sorts of weathers.

Working Expenses of Gas Works.—Having now given you thus much from my notebooks, experience, and observation as to the normal proportions and cost of soundly-constructed gas works, rated at per ton of coals carbonized, for examples where the engineer has anything like a free hand, or *carte blanche* given to him, we can arrive at the amount to be paid as a reasonable dividend per 1,000 cubic feet of gas sold to the consumer. By returns of gas works, old and new, most of them encumbered with used-up plant and structures, and "loaded" or 'watered" capital not written off, the interest paid per 1,000 cubic feet of gas *sold* is somewhere between 5d. at busy Manchester and 2s. at classical Harrow. But supposing the structural works to cost as before detailed, then 4½d. per thousand cubic feet of gas sold would be all that was required to pay 5 per cent. interest on the capital expenditure. The capitals of the various gas companies run from about £2.4 to over £50 per ton of coal per year. The working expenses, less cost of coals, which vary much at different places, need never exceed 10s. per ton of coals carbonized, or about 1s. per 1,000 cubic feet of gas at the consumers' meters; instead of which one finds they reach from 8s. 3d. per ton at Newcastle-upon-Tyne to 18s. at Harrow. The working expenses of a concern per ton (less coals) is the most crucial test by which to compare the operations of different gas works, as labor charges are tolerably uniform throughout the country; but coal prices vary as much as from 6s. to 18s. per ton in the retort house. And yet the management of some gas works must be at fault; for we find that the charges for labor, purification, and maintenance of works, including distribution, varies in different establishments from 6s. 8d. at Newcastle-upon-Tyne to 10s. 2d. in the case of the Gas Light and Coke Company, and up to 12s. per ton elsewhere. The supervision of the labor departments at gas works should be more keen. The manager need not spend so much of his time in the laboratory. There are good, kind, and well-educated gentlemen in charge of many gas works who do not like to cope with the "loafing" labor which requires weeding out. The time-sheets want a little of the laboratory system of analysis applied to them. Frequently the grains and volumes of the several gases are delicately sifted out and recorded in the laboratory; whereas outside in the yard and on the works the golden sovereigns are running away through the wide-mesh seive of shuffling and dawdling labor. We cannot, however, all of us be all-round men and keen observers in our several positions of life, as well as scientists, test-tube shakers, and geniuses; but yet we are all expected in this advanced age of board schools to take off our hats to the scientist and retire to a back seat to observe his evolutions and pyrotechnics.

The Price of Gas in the Future.—From all future extensions and new works we must endeavor to supply and sell gas to the public at the lowest possible cost, to ward off competition from all sources, petroleum or otherwise; and for this purpose when coals can be delivered into the retort house at from 10s. to 12s. per ton, with residuals only producing about half the cost of coals, to sell the best 16-candle gas to the consumer at a price not exceeding 2s. per 1,000 cubic feet, *including meters and external services.* Thus: 1s. working expenses, 4½d. interest, and 7½d. coals, less residuals—in all, 2s. per 1,000 feet. This would then lift the gas stocks on the money market to a selling price of £100 for every £4 5s. of dividend, as with the leading railway stocks. Some gas experts assert, and they are not far from the mark, that if dividends of 4 or 5 per cent. were paid on gas stock instead of 12 and upward, gas might be sold to the consumer at 1s. 6d. per 1,000 feet in most of the large towns. I have an instance before me of a gas works which carbonizes, in round figures, 90,000 tons of coals per year; pays 9s. per ton for its coals in the retort house; the total working expenses (less coals), 9s. per ton; sells residuals at half the price of coals (like the Gas Light and Coke Company), leaving the latter at the net cost of 4s. 6d. per ton; and the net cost of gas, without interest, at the consumers' meters is 1s. 3d. per 1,000 cubic feet. The gas, however, is sold at 2s. 4d. per 1,000 cubic feet, the remainder going for interest and reserve fund. Nearly 10,000 cubic feet per ton are sold. In these works the structural value would not exceed one-half the capital recorded upon the books of the undertaking. Fancy a profit of 87 per cent. on the manufacturing cost of the vended article for dividend. Let us turn over a new leaf, and calmly await the future and fate. Let us do the best we can for the public, and not give the slightest cause for gas companies being called, as they have been, "Gas Trust Robbers," who must be thrown flat on their backs by competition.

I have laid as much as I can before you on this subject, and I have made it as practical as I can—from actual data. If any of you have had any difficulty in understanding any of the items, I shall be pleased to answer all questions which may be put.

Turning the Tables.

Under the heading of "The Gas Man's Joke," the Cincinnati (Ohio) *Telegram* recently published the following:

Some time ago a gentleman calling himself a gas meter expert arrived in Cincinnati from Chicago. He began operations by announcing himself a life-long enemy of gas companies generally, because gas companies were all robbers; and he was prepared, he said, by the aid of a test machine which he carried with him, to detect all dishonest gas meters. His charge for testing meters was $5 each, which sum, he plausibly explained, could be saved in one month's gas bill if the meter in use was

measuring more gas than was consumed. So it was natural that in a short time he should find himself overwhelmed with orders from people wanting their meters tested, who were morally sure that they were being robbed.

Now, as a matter of fact, gas meters are as apt to be wrong as they are to be right, and they are, moreover, just as apt to have a weakness for not measuring enough as they are for measuring too much. This simple proposition anyone who is at all familiar with the construction of meters of any kind will understand.

And so in this case, while the expert found that all whom he approached were satisfied they were paying for more gas than they consumed, he found, also, in his three months' sojourn, that of the meters tested there were more of them rusty and slow to work than the number which, from leakage or other cause, measured more gas than was really consumed. Over a thousand meters were tested by him during his short stay here netting him a handsome return, and as was his practice, merely as a matter of form (?) he kept a journal showing the readings of each test, with the per cent. figured out of the excess or shortage, where located, the consumer's name, etc.

Those meters found to be measuring too much gas were promptly reported by the unfortunate possessor to the Gas Company, with a demand that the meters be at once removed and accurate ones put in their places. This was how the Gas Company heard of the Chicagoan's presence, and it took but little investigation on their part to learn just what was going on. The Company was also impressed by the singularity of the fact that all the complaints coming in were concerning meters measuring too much gas; not a complaint of meters short in their measurement. So a note was sent to the Chicagoan by the Gas Company something to this effect:

"My Dear Sir:—When you have completed your work of testing the gas meters in the city, if you will call at the office of the Cincinnati Gas Light and Coke Company, I am warranted in assuring you the visit will result to your advantage."

This message was duly signed and forwarded to the expert's address, and in a few days, having completed his work, the expert called on the Gas Company. He informed the Company that he had tested something over 1,300 meters, and in reply to questions said he had kept an account of the readings of each one of them.

"We will pay you 50 cents for every name with the result of the tests," said President Hickenlooper.

"I'm your man." said the Chicagoan. "I'm in the business to make money, and the names are yours."

Then the real music began. It was found that there were 300 or 400 meters in use in the city that were measuring gas too slow, and men were at once sent out by the Company to replace them with new meters.

One of the funniest incidents was that of Moses Kahn, who keeps a misfit clothing establishment at Seventh and Vine streets.

"So hellup me gracious!" he said, to the Chicago expert when he went to test his meter, "dot Gas Gombany was robbin' me. Tey are a lot of public tieves."

When the expert, after testing his meter, told Mr. Kahn that it was measuring only 50 per cent. of the gas he was actually consuming, he patted the expert on the back and said:

"Don't say a verd, young man—don't say a verd. Tey are robbers."

So when the Gas Company's man called on Mr. Kahn with a new meter, Mr. Kahn said:

"Who said I vant my meter shanged?"

"The Gas Company," replied the meter man.

"De Gas Company, eh? Vel, my meter suits me. I make no gomblaint."

"But I am sent here to make the change," persisted the gas man.

"Vell, I don't vant it shanged. Don't you know someding ven a man don't make some gomblaint?"

"Sorry, sir; but I must do my work," said the gas man, starting to go into the cellar.

"Shtop, you!" excitedly cried Mr. Kahn; "vere you go—into my cellar! Public robbers and tieves! You lot of tammed robbers! You shange my meter if I don't like it."

And Mr. Kahn went on relieving himself to his heart's content respecting the robbing proprietors of gas companies, when the gas man was making a change of the meters. When the gas man returned he hailed him with:

"De man vot charged me $5 vas a tammed rascal, too—a dirty shpy of de Gas Company. Dey are all robbers."

And there were lots of people who paid $5 for the sake of seeing their meter taken out and replaced by one that measured enough gas.

SPECIAL ENGLISH CORRESPONDENCE.

Communicated by Norton H. Humphrys.

Salisbury, Nov. 10, 1887.

Sensational Gas Management.—Cheap Gas.—Purification in situ.—Tar Useless for Gas Making.—Gas for the Million.—Reduction in Price.

One would imagine that the history of a gas undertaking must necessarily be of a dry and musty sort, partaking of the nature of those Parliamentary papers which are issued for the delectation of members of that august assembly. Yet sometimes it is not wanting in romance—of a kind. An unexpected action on the part of the directorate is as entrancing, to the professional mind, as the "situations" which are so greatly favored by artists of fiction. It really appears as if the Gas Light and Coke Company, of London, desired to be sensational in a technical way. Only last September I was remarking upon the extraordinary manner in which their profits had jumped up during the last half year; and now comes a fresh surprise. On the 1st day of January, 1888, the price of gas is to be reduced to the extent of 6 cents per thousand cubic feet in the case of common gas, and 8 cents on the cannel gas. This will bring the price to ordinary consumers down to 66 cents per 1,000 cubic feet of common gas, and 82 cents per 1,000 cubic feet of cannel gas; the public lamps being supplied at a cheaper rate, viz., 52 cents and 64 cents respectively. The consumers, of course, are glad of the reduction, and so, strange to say, are the electricians. This is not a specimen of genuine disinterestedness. They welcome the change because it will render motive power of the gas engine kind cheaper. Such independent testimony as to the value of gas engines is very acceptable. The importance of this reduction is rendered more apparent when we look at the fact that the gas was already sold at a comparatively low rate. A 6 cent reduction would not look much, for instance, on the Paris price, which is more than $1.50 per 1,000 cubic feet, but when applied to a 72-cent rate, it means one-twelfth part of the whole. It means to the Gas Light and Coke Company a diminution in gas rental to the extent of 8½ per cent., or about the sum necessary to pay the dividends; and when it is remembered that the shareholders do not expect any falling off in the amount of profit earned, we may well call this sort of financiering by the term of "sensational." I remember that in the time of the coal famine some gas companies pulled through by dint of much scheming and economy without raising the price of gas. In many cases the result was not, as might be expected, gratitude on the part of the consumers; but the amiable suggestion that very excessive profit must have been the rule before the famine, and as soon as coal had resumed its normal values a prompt demand for a reduction. In a similar manner large reductions are usually received with a certain amount of suspicion. The present case is no exception, for already there is some talk of an agitation for the abolition of meter rents.

This 8½ per cent. reduction, however, will afford interesting information for the use of the gas profession generally. Gas engineers have heard so much lately about "cheap gas" that the expression has almost the same effect upon them as the mention of the word "jubilee" on the ordinary British citizen. Not that the latter is disloyal, but he has heard so much about the jubilee festivities during the past few months that he is tired of it, just like a child that has eaten too much jam. Anyone making a joke about the jubilee is promptly ignored as an offensive character. And really there has been so much said and written about selling gas cheaply of late years that the subject grows wearisome. Here, however, is an experiment on a gigantic scale. The effect of this large reduction, as regards the gas supply in the district, will be carefully watched by those who advocate liberal concessions to consumers, and by those who do not; and, as is usually the case, both sides will select evidence from the results in support of their own views.

Mr. S. Penny has recently made an interesting communication to the *Journal of Gas Lighting*, on the subject of oxide purification *in situ*, by admitting a trifling proportion of air to the gas before purification. The objection hitherto felt against this process is the effect of the residual nitrogen on the illuminating power of the gas. Mr. Penny claims that if the air is admitted at the hydraulic, while the gas is warm, a certain amount of carburetting action takes place; so that, practically, the quality of the gas does not suffer. He uses, on the average, two per cent. of air, which leaves about 1½ per cent. of nitrogen mixed with the gas, and claims to have introduced as much as three per cent. of air at the hydraulic without any deleterious effect on the illuminating power.

It would be interesting to carry these experiments further and ascertain how much loading with air the gas would stand. Mr. Penny also claims, as an advantage in connection with the air system, that the

chemical action in the purifiers causes a slight increase of temperature, so that the gas leaves the purifiers some 15° to 20° higher than it enters. This he considers improves the illuminating power of the gas. In severe weather it would certainly be of benefit, for the illuminating power often suffers if the temperature of the purifier falls, say, to freezing point. But the question of introducing diluents in any form into gas is one that must be carefully considered on all sides. The experiments made by various observers agree in showing that their depreciatory effect is much more marked in the case of flat flames and small burners than with the standard burner. Mr. J. T. Sheard found that a proportion of carbonic acid which only influenced the illuminating value of the gas when used through a standard Argand burner to the extent of three per cent. reduced it some ten per cent. when the Argand was replaced by a flat flame burner. My own opinion is that a gas free from diluents burns with a whiter and better looking flame, especially in small burners, than another of equal illuminating value, but containing perhaps two or three per cent. of nitrogen, carbonic acid, etc.; and therefore I always prefer to purify the gas by means of lime rather than to bring up the illuminating power with cannel. I have repeatedly turned off the lime purifier and used more cannel so as to keep the photometrical value from falling off; but have always found that complaints are made to the effect that the gas is not so bright as usual. Remembering that nine-tenths of the gas is burnt through flat-flame burners, Mr. Sheard's results serve to explain this experience.

M. Grebel, Engineer at the Guise gas works (France), has lately been trying some experiments with tar as a gas making material, according to a plan proposed by M. Eichelbrenner. This system consists of mixing the tar with a considerable quantity of solid materials such as lime, sawdust or small coke, to enable it to be charged into the retorts in the same way as coal. The mixture is used in the retort house instead of that substance in the proportion of about 10 per cent. The plan does not answer, because the gas evolved from the mixture is so inferior in lighting qualities as to be practically non-luminous, probably by reason of a large quantity of carbonic acid being evolved from the sawdust. Two kinds of mixtures were used, the first consisting of equal parts by weight of tar and whitewood sawdust with 10 per cent. of lime, and the second of two parts tar to five parts coke dust. The gas evolved from the coke dust mixture was rather better in quality, but still very inferior. The yield was very low as regards quantity, and the cost of the mixture, including extraneous ingredients and labor, was nearly as much as that of coal. M. Grebel considers that tar is far more valuable as a fuel than as a carbonizing material. He uses it under the retort fires, and finds that ten parts of tar are as good as seventeen parts of coke. Tar has been repeatedly tried in ordinary retorts, usually by admixture with small coal, but with no success.

An interesting attempt is to be made at Denton, in the way of competing with cheap petroleum. Mr. J. M. Veevers, the Manager of the gas works (which belong to the local authorities), was instructed some time since to prepare a report for his Committee on the subject of the competition to which coal gas was subject by other lighting agents in the district supplied by them. In his report Mr Veevers states that the use of oil lamps is extending amongst the poorer classes, because the lamps are cheap and the oil can be bought in small quantities; whereas with gas the fittings are costly, there is a meter rent to pay, and the bill is presented at long intervals when it has attained comparatively large proportions. In order to meet these objections he proposes to abolish meter rents, and to collect a small sum weekly, say, 7 cents in summer, and 13 cents in winter, from those who are placed on the weekly supply system. The meters are taken, and the accounts made out quarterly, as usual, and the weekly payment is placed to the credit of the account. If any balance is found to be due from the consumer it is collected as an extra, or if, on the other hand, the Company have received more than is due, the balance is returned, or carried forward, as may be desired. The Committee have resolved to make a trial of the suggestion. It will be observed that it does not touch upon the cost of gas fittings. Most of the houses in the district are provided with these furnishings by the owners, so it was considered that this point did not call for attention at present. For sometime past the system of weekly payments has been in use amongst the operatives in Manchester, and I am told that the South Metropolitan Gas Company are trying an experiment in this direction. I also know that there is at least one gas undertaking who have made a practice of letting out on hire not only gas cooking stoves, but also gaseliers and fittings of all kinds, for many years past. At present gas consumption shows a satisfactory increase without resorting to any of these aids, and so long as this is the case they are not likely to be adopted to any great extent, notwithstanding the fervent exhortations of those who anticipate a day of brisk competition to be at hand. Once, however, let two or three undertakings find their consumption falling off and the whole will take fright. These systems will then come in with a rush. There is much truth in the proverb, "make hay whilst the sun shines," and it behooves the managers of gas undertakings to make their positions as secure as possible whilst they are undisputed.

Several reductions in price are announced in different parts of the country. At Plymouth, where the charge for gas is already at the low figure of 44 cents, a reduction of two cents has been made, bringing it down to 42 cents, the lowest price at which gas is retailed in England. The Ventnor Gas Company are rapidly improving in circumstances, having reduced their price no less than 32 cents within the last four years. At Neath a similar policy has been followed. At Halifax the present price is 52 cents in the borough, and 76 cents on the outskirts; an all-round reduction of 4 cents per 1,000 is to be made, and large consumers will be allowed discounts after the rate of 8½, 10, or 12½ per cent. according to the quantity consumed. The Redcar Gas Company announce a reduction of 12 cents per 1,000 cubic feet, with a ten per cent. discount for prompt payment, and they are also introducing the system of differential prices, by allowing an additional discount of 25 per cent. on all gas used for cooking or for motive power. This system, by-the-way, has recently been adopted at Berlin, where a discount of 20 per cent. is now allowed on all gas used for other than lighting purposes. At Seaford a reduction of 10 cents has been made. The Huddersfield Corporation have decided to offer gas for cooking, motive power or technical purposes at 48 cents, an important reduction on the current rate. These are simply a few instances that come to mind at the moment, and they serve to show that the gas industry is advancing, also to illustrate the ignorance of those who assert that gas engineers are satisfied to trot along in the old ruts. How could such large reductions be made in the absence of important improvements at the works? Increase in consumption and cheap materials account for them in some degree, but are by no means sufficient to cover the whole.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Annual Election, Rahway, N. J.—The stockholders of the Rahway Gas Light Company have chosen Messrs. J. R. Shotwell, Wm. Mershon, W. B. Houston, W. C. Squier, J. Osborne and Jas. Vanderhoven to act as a Board of Directors during the ensuing year. Mr. Shotwell acts as President and Treasurer, Mr. Houston filling the triple position of Secretary, Engineer and Supt. The careful management of those in charge of the Company's fortunes is rapidly advancing its financial standing.

A Line from Pawtucket, R. I.—Brother Stiness evidently means to keep the Pawtucket Gas Company's plant up to the highest standard, for he has empowered the Jarvis Engineering Company to add thereto an Armington & Sims' engine and two tubular boilers, to be set in accordance with the Jarvis Company's plan of boiler setting, which, as our readers are aware, permits of the economical and satisfactory use of coke and coke screenings for fuel. The Pawtucket gas shareholders have abundant reason for satisfaction over the way in which their property is conserved.

The Braddock (Pa.) Company Once More in Line.—The dollar rate for gas is no longer a stranger to the States; in fact, '87 has conclusively shown that the long-looked-for figure is about to reveal itself frequently within the coming twelvemonth. To this, of course, we can only say the oftener the better; and perhaps we may soon take up the hope that another shilling will be clipped from the hitherto long-wished-for "dollar goal." Certainly, it is going to be much harder work to get down to "seven shilling gas" from the dollar notch than it was, say, to recede from $1.25 to $1; but the American gas maker is bound to achieve that which he starts out to gain. We venture to hint at seven-shilling gas on account of the action lately taken by the owners of the Braddock Gas Light Company, whose territory (although most favorably situated for the cheap manufacture of illuminating gas) is but a comparatively small one—that is, in respect of population, wealth, and so on. However, the proprietors have taken the bull by the horns, and the following schedule shows whether they mean business or not:

Monthly Consumption.	Net rate per M.
Under 3,000 cubic feet	$1.20
3,000 to 10,000 "	1.10
Over 10,000 "	1.00

These concessions operate where payment of accounts is made on or before the 10th day from presentation of bills, and those failing to settle within the prescribed time will incur a penalty of 10 per cent. for their

delinquency. The prior rates were the following: Under 3,000 cu. ft., $1.40; over 3,000 cu. ft., $1.20. We are indebted to Mr. James S. Kuhn, President of the Company, for the details above given, and we cannot forbear to here quote the following lines from his courteous letter to us on the subject: "Since we have owned the Braddock gas works we have made frequent reductions in the selling price of gas, and, as you will notice, our last rate brings us down to the lowest price at which gas is sold in Pittsburgh or Allegheny City. Such a low figure in a town of the size of Braddock is very unusual; but our Company has always adhered to the policy of selling gas as cheaply as possible. The consumption of gas in Braddock is constantly growing, hence with the large gain in consumers we have been enabled to operate the plant more economically, and have given our patrons the benefit of such gains by our last reduction in the selling price. Our Company has also decided to put in an electric light plant at Braddock, as a number of the storekeepers desire to use that method of illuminating their places of business."

Mr. Napoleon Aubin is the official Gas Inspector for the Dominion of Canada. His headquarters are located in Montreal.

PUBLIC LIGHTING, MERIDIAN, MISS.—Through the efforts of Secretary Robinson, of the Meridian Gas Light Company, the authorities of that city recently awarded a contract for the public lighting to the Company. The agreement calls for the maintenance of 100 gas lamps, lights to burn every night and all night, to be paid for at the rate of $3 per lamp per month, the contract to run for five years from Jan. 1, 1888. The representatives of several electric systems tried to convince the City Fathers of the economy and efficacy of electric lighting, but without avail. Secretary Robinson proclaimed to the authorities his willingness to establish an electric lighting plant, if it were deemed best to change the system of public lighting.

THE KERR MURRAY COMPANY'S LIST.—President Cressler writes that his Company, in addition to the complete 8-inch works ordered by the Charlottesville (Va.) Gas Company, has the following work underway: A set of 5 ft. by 5 ft. purifiers, and other extensions as well, for the Paris (Texas) Gas and Electric Light Company; an iron roof for retort house, boiler, etc., for the Northwestern Gas Light and Coke Company, Evanston, Ills.; and 14 benches of sixes, with self-sealing mouthpieces and anti-sealing dip-pipes for the Memphis (Tenn.) Gas Light Company.

A HINT FROM APPLETON, WIS.—Under the management of Mr. H. T. Hardcastle, formerly in the employ of the Equitable (Chicago, Ills.) Company, the Appleton Gas Light Company's sendout has been largely augmented. This, too, despite the fact that the local plant maintained by the Edison Company is intended to operate in the nature of a standing advertisement, for the greater part of Wisconsin, of the excellencies of the wizard's pet lighting method.

THE San Rafael (Cal.) Gas Company has determined to add an electric light annex to its present plant. It is expected to complete the work of construction, etc., by Jan. 15.

SEND IN YOUR NAMES.—On July 1 the Committee on Publication, Franklin Institute, issued a circular conveying the information that they contemplated the publication of an index of authors and subject-matter contained in the first 110 volumes of the Institute *Journal*, provided a sufficient number of subscriptions (at $5 each) could be obtained to cover the cost of the work. The value of the proposed index would be very great to those who possess any considerable number of the volumes in question, and we are not so sure but that it would be equally great to newspaper writers, patent attorneys, specialists, etc. Certainly it would save these latter much time when desirous of hunting up information of especial value to them at the moment; for the *Journal* contains copious and, best of all, reliable mention of things connected with the development of science and the mechanic arts in this country during the last 61 years. We regret, however, to say it has been found necessary to issue a second circular in connection with the project, but hope to add shortly that the requisite guarantee has been obtained. Many a gas man would find in this Index a valuable addition to his library. Subscriptions should be sent to Mr. H. L. Heyl, Actuary, or to Dr. Wm. H. Wahl, Secretary of the Institute.

PUBLIC LIGHTING, ALTON, ILLS.—The City Council has awarded a contract for the public lighting to the Alton Gas Light and Coke Company, a mixed system to be followed. Under the agreement the Gas Company will maintain 20 arc lights, in addition to the full complement of gas lamps hitherto employed. The arcs are to cost the city $100 each per annum.

TURNED ON.—The plant of the St. Clair (Mich.) Gas Light and Fuel Company having been completed, St. Clair's residents are now basking in the light of the present. St. Clair is located at the mouth of Pine river, is 12 miles south of Port Huron, and 48 miles (by water) northeast of Detroit.

WE understand that construction work is to begin forthwith on the gas and electric light plant intended for the lighting of Gainesville, Fla. This place is the capital seat of Alachua county, being located about midway of Jacksonville and Cedar Keys.

INEXPEDIENT.—A Committee appointed by the Wakefield (Mass.) authorities to inquire whether it would be prudent to employ electricity as a public lighting agent has reported that "it would be inexpedient to make the change from gas." Reason, the expense would be about twice as great—quite sufficient, too.

CAUGHT.—Some time ago two clever sneak thieves stole about $500 from the office of the Roxbury (Mass.) Gas Light Company, the robbery being effected in business hours, and with the greatest coolness possible. Two of the "operators," much to the surprise of those who suffered, have been enmeshed by the police. They—the "operators"—are stars in the "crooked" firmament, and answer respectively to the names of George Carson and Rufe. Miner. They were arrested in Chicago, Ills., on the 15th ult. Chief Inspector Hanscom, of Boston, must be a pretty clever detective, for it was chiefly through his sagacity that the purloiners were "pinched," to use the Vidocq vernacular.

OBITUARY NOTE.—We are pained to say that the fraternity has lost a valued member in the death of Dr. W. R. Tomkins, who for years was prominently identified with the best interests of the city of Gallatin, Tenn. While the Doctor never came publicly before the recognition of the fraternity, he nevertheless was held in warm esteem by the gas men of the South and Southwest; but his demise will be especially felt by the proprietors of the Gallatin Gas Light Company, whose President he had been. *Vale!*

HIS SUCCESSOR.—The death of President Tomkins necessitated the holding of a special meeting of the stockholders of the Gallatin Gas Light Company. The ballot resulted as follows: The Directorate vacancy was filled by the election of Col. James Alexander, then the Board organized by selecting Capt. Geo. Harsh to the Presidency, D. K. Anderson being chosen Secretary, the Treasurership falling to T. H. King.

SOLD.—We hear that Mr. John Q. Brown, of Sacramento, Cal., has sold out his interest in the Woodland gas works (same State) to a local syndicate. The purchasers paid $12,500 for the Brown interest; and as that means control of the Company, we think they got a bargain, and a good one.

A LIVELY LIST OF "WESTERN WAIFS."—Supt. Feeney, of the Lexington (Ky.) Gas Company, reports satisfactory business and pleasant prospects. To keep pace with the growth of the city the main mileage has been extended, the City Council having recently ordered the placing of new lines over which a number of public lamps will be located.——The Hamilton (O.) Gas and Fuel Company some time since applied to the City Fathers for permission to lay mains and manufacture gas. The request was submitted to the people, who, on Nov. 8, indorsed the project, giving thereto a majority of 1,226. The same Company is operating at Bellevue, Ky.——The old Hamilton (O.) Gas Company hoped to have its electric lighting plant in operation on the 1st inst. Some delay occurred on the part of those who agreed to furnish the apparatus, but Supt. Hensley, with his characteristic energy, has made things lively around him since the receipt of the machinery. He does not seem much alarmed at the prospect of a competing gas company.——Said Manager Fullager, of the Georgetown (Ky.) Gas Company, to your correspondent: "Our business has been unusually good this year, and the outlook is encouraging. Our consumers' list has increased 50 per cent. within the past two years, and we are, with becoming regularity, adding to the number. We made many needed extensions during the summer, and, among other improvements, built two new benches of 3's. Now we are ready for the winter's work." Mr. Fullager has had erected for himself one of the handsomest homes in Georgetown. It was completed in time to enable him to eat therein his Thanksgiving turkey.——Energetic Superintendent Shea, of the Frankfort (Ky.) Gas Company, was discovered by your reporter crowded with work—endeavoring to have his affairs in complete order for the winter's campaign. The manufac-

turing apparatus (water gas) having received a thorough overhauling, is now a model specimen. Many new services have been run and old ones renewed.——The scarcity of coal in the country tributary to and dependent upon Cincinnati and the Ohio river for its supply is causing a world of trouble to the gas companies. Not for months has a barge load of coal passed down the river, the Ohio being at a lower stage, and for a longer period, than the "oldest inhabitant" can recall. The railroads west of Pittsburgh find it impossible to obtain enough cars to supply the demands made on them. Their roads are covered with extra coal trains for the West, and trains of "empties" on the way back to the mines. To add to the distress, well-grounded fear of a "freeze-up" is entertained —a cold spell, in the present condition of the river, is sure to close it.—— Ald. Hodgden, of Lake View (a Chicago suburb), Chairman of the Committee on Street Lighting, has recommended to the Council the building of gas works by the city. This honorable gentleman says the necessary plant, including 15 milles of mains, can be secured at an outlay of $96,000, and that gas can be sold at 50 cents per 1,000 cu. ft.! Action on the matter has been deferred.——The Toledo (O.) Gas Company has run natural gas into its retort house, and will use it for fuel under the benches.——The recent cold snap affected the pressure and supply conditions of the natural gas mains at Lima, O., and caused considerable dissatisfaction among the residents who depended solely upon gas for fuel. The happening boomed the Lima coal market.——The latest news from the Sandusky (O.) natural gas well advises that the drills have penetrated 150 feet into the Trenton rock, and yet no hopeful indications. W. H. Murphy, of Cleveland, has asked permission of the Council to bring in the gas from the Oak Harbor—about 24 miles east by south of Toledo—wells. His request will be granted.——Heretofore it has cost something like $3,000 per annum to light the streets of Glendale (O.) with gas. Bids for a 5-year contract have just been opened, and the probabilities are that an attempt at gasoline lighting will be made—a company having agreed to light with that odorous agent at about one-half the former cost. DIAPHRAGM.

THE OMAHA (NEB.) EXPLOSION.—The explosion that occurred last month in the generating house of the Omaha Gas Manufacturing Company's plant occasioned much inconvenience to the inhabitants. Luckily the pecuniary loss to the proprietors was not of a serious nature, although it might easily have been otherwise.

MORE BENEFACTORS.—The Fire Committee of the San Francisco (Cal.) Board of Supervisors have been appealed to by the projectors of the Standard Gas Light and Fuel Company for permission to construct a manufacturing plant on the site of the old Selby Smelting Works, which is located within the fire limits of the city. J. D. Boyer, who appears to be Secretary of the Company, the latter seeming to be a branch of the ex-high pressure concern, which, in time(?) is to dot Manhattan Island over with "storage tanks and gas works"—spoke in favor of the plan, and guaranteed, if the coveted permission were granted, to eventually furnish gas at a price at least 50 cents per thousand lower than that now charged in San Francisco. The existing companies will "eventually" do the same thing, if left to themselves; and it will be only postponing the "eventuality" if permission be now accorded the petitioners to enter San Francisco's artificial lighting field. The Committee is "investigating" the merits of the application.

The Massachusetts Gas Commission has authorized the Lawrence Gas Company to engage in the business of the manufacture and distribution of electricity.

We understand that the Big Rapids (Mich.) Gas Light Company will make an important reduction in gas rates on Jan. 1st.

THE SALE OF NATURAL GAS IN THE CITY OF MORMONDOM.—A correspondent sends the following: "The Salt Lake City (Utah) Gas Company has applied to the City Council for a grant of the sole franchise for the introduction and sale of natural gas in the city. The application was accompanied by a draft of an ordinance covering the conditions of right, etc. It is proposed that the franchise run for 10 years; that the Company be not required to lay pipes in the city until such time as the natural gas shall have been conveyed to the boundaries thereof, if the gas be found at a distance from the city limits; and that the Company shall pay to the city for the said franchise 15 per cent., monthly, of all revenues or amounts received from the sale and use of said natural gas, and, in addition, annually pay into the city all net profits realized on such sales and uses in excess of 7 per cent. upon the amount of money actually invested by said Company. The petition and ordinance were referred to the Committee on Streets and Alleys."

The Salem (Mass.) Gas Light Company is putting in a new 10-inch main on Boston street, in order to cope with the greatly increased demand for gas in the upper sections of the city. This tells whether or not Brother Moore's folks are satisfied with the outlook. To us it looks as if they were.

The Conshohocken (Pa.) Gas Company is putting in an electric light plant, the contract for which was awarded last week.

AN INTERESTING LEGAL DECISION.—On November 21 word was received that the Supreme Court of West Va., in determining the case of the proprietors of the Parkersburg Gas Company vs. the local electric light company, had decided in favor of the latter. The history of the case is about like this: A number of years ago the Parkersburg City Council granted the Gas Company the exclusive right to use the streets and alleys for the purpose of supplying through them, by appropriate means, the illuminating agent for the lighting of the city. Some years thereafter an electric light company was formed, whereupon the reigning Council granted the electricians the privilege of lighting the city. The latter put up poles and strung wires, but just prior to the starting of the plant the Gas Company sued for an injunction restraining the Council from carrying out its pledge and estopping the electricians from supplying light either to the city or to private consumers. The case was brought in the State Circuit Court, and Judge Jackson, before whom the matter was argued, decided that the contract entered into by the city with the Gas Company was binding—in so far as the public lighting was concerned, and that *no other* company could light the city until that contract expired by limitation. He, however, also ruled that the electricians could proceed with the work of lighting private buildings. Neither company was satisfied with Judge Jackson's decision, and the case was taken to the Supreme Court of the State, whose magnates have asserted that the contract made with the Gas Company is not of a nature to preclude the Council from contracting with the electric company for either public or private lighting. The Court also denies the right of any City Council in West Virginia to grant an exclusive contract of the nature under consideration to any company. The "exclusive" pledge given to the Parkersburg Gas Company would lapse by limitation, in 1898. It is curious to note how frequently great minds—particularly those that are paid for construing the law—differ when pondering over cases whose legal aspects are to all intents and purposes identical. We are, however, disposed to assert that if this case were carried to the U. S. Supreme Court, the verdict of that tribunal would be in direct conflict with the one just formulated by the Dogberrys of West Virginia's Supreme Court.

The Corsicana (Texas) gas plant, which has been shut down for some time, has been fired up. I. Barry is in charge.

KILLED—Jno. Barnicle, employed as a lamp trimmer by the Burlington (Iowa) Electric Light and Power Company, while in the performance of his duty, received a fatal electric shock.

The Springfield (Mass.) Gas Light Company's sendout for last October exceeded that of the corresponding month in '86 by one million cu. ft.

It will cost about $140,000 to light the streets of Washington (D. C.) in '88, of which sum $30,000 will be expended in arc lighting. Two hundred and fifty gas lamps are to be put up, bringing the total of these up to 4,767.

F. B. Ainger and others have filed articles incorporating the Sturgis (Mich.) Gas and Electric Light Company. Capital, $120,000. Sturgis is a village of St. Joseph county, and is 24 miles west by southwest of Coldwater. Population, about 3,200.

We understand that the works of the Fremont (Ohio) Gas Company are being adapted to meet the requirements of the McKay-Critchlow system of manufacture. The proprietors expect, in consequence of the new departure, to put the Fremont selling rate at $1 per thousand in the near future.

WHAT THE WATERHOUSE ELECTRIC MANUF'G COMPANY IS DOING.—The proprietors of the Waterhouse Company, of Hartford, Conn., are not making any great noise over their operations, but their system of arc and incandescent lighting nevertheless rapidly gains favor. Not long since the Otto Gas Engine Company tested in a practical way what could be achieved by the Waterhouse plan of arc lighting, using an Otto engine to drive the dynamos. The Otto folks returned a most satisfactory report at the conclusion of the experiment, making especial mention

of the steadiness of the illumination obtained. Best of all, the regularity was not secured at the expense of economy, since we are told that the number of lights maintained from the duty of the engine exceeded, by about 25 per cent., those obtained under like circumstances when other arc systems were being experimented with at the Otto shops. The Waterhouse plant—of the ¾-arc type, for 8½ ampere current, and driven by a 25-horse power Otto engine—recently put in operation by the Washington (Ind.) Gas Light Company, is giving unequivocal satisfaction to its purchasers and the people of that city, unless the local newspapers are wrong in their conclusions. This is what the Washington *Gazette* thinks about it: "Our system of electric street lighting is a pronounced success, and meets with favorable comment from all the traveling men who visit our city. Several of these have expressed their opinion on the topic to our reporter, and they all agreed in saying our Washington light is superior to the best electric street lights seen by them in other places. It is steadier, clearer and brighter than those produced by other systems." The Waterhouse Company claims that its ¾-light can be produced at an expenditure of power similar to that required for maintaining standard ½-arcs of other systems; further, the illuminating effect from the Waterhouse ¾-arc is 33 per cent. greater than that given by the standard half specimen. Orders now in hand for Waterhouse plants include one from the Grass Valley (Cal.) Gas Company, and a 500-arc capacity specimen for Baltimore, Md. The proprietors of the Fresno (Cal.) Gas Company thus record themselves: "During the six months' test to which we have subjected the plant we have had every opportunity for judging of the merits of the Waterhouse system of arc lighting, and do not hesitate to recommend it." In consequence of the demands made upon their resources the Waterhouse folks have been obliged to double the manufacturing capacity of their factories, and are now ready to promptly answer the calls of their patrons.

DISMISSED.—Some of the opponents of the Louisville (Ky.) Gas Light Company, whose scent for fraud was vastly more acute than was their ability or desire to comprehend in the open actions of reputable and fair-dealing fellow townsmen anything that differed from the usual business course of the latter, charged Messrs. Jno. M. Atherton, Jacob Smyser and Henry Bishop with bribery during the last local election. Waxing strong in their indignant righteousness, the unbribed went before the last session of the Grand Jury, and, on information and belief—no doubt the latter element entered largely into the information—charged the before-mentioned with "feloniously appropriating the funds of the Louisville Gas Company to their own use and to the use of others, with intent to cheat said Company and the stockholders thereof." Continuing, the righteous concluded, "They did, without the authority of the President and Directors of said corporation, unlawfully, wilfully, fraudulently and feloniously appropriate a large sum, to wit, $10,000, the property and funds of the Louisville Gas Company and the stockholders thereof, to their own use, and to the use of other persons unknown to us, with the fraudulent intent to cheat and defraud the said corporation." The Grand Jury, having listened to the fund of information and belief in the possession of the righteous, promptly bundled them out of court, to nurse in impotent wrath the fancies of their diseased imaginations.

HOPKINSVILLE, KY., had a sensation the other day when Walter Hawley, the 11-year-old son of J. F. Hawley, Manager of the Hopkinsville gas works, ignited a match on the iron tank used for storing oil. The lad intended to light a cigarette, but paid dearly for his thoughtlessness, since the tank exploded, inflicting injuries on the unfortunate youth that caused his death.

WILL THEY GO BACK TO IT.—The Baltimoreans having become so habituated to 50 cent gas during the continuance of the lately terminated war of rates, do not take kindly to the new schedule, although the latter is far from being an oppressive one. The authorities also share in the feeling of discontent, and possibly sober old Baltimore is about to go to the ancient practice in vogue—that of putting out (rather, not lighting them at all) the street gas lamps when pale Luna is down on the tables to remove her veil. At any rate a correspondent, who usually knows whereof he speaks, says that the change is likely to be made, giving in support of that view the following reason: "The Mayor has had a conference with F. W. King, Gen. Supt. of Lamps, relative to the cost of lighting the gas lamps all night and on nights or parts of the same when the moon is in her dark phase. The Mayor says that his predecessor very properly ordered the lamps to be burned all night when the price of gas was 50 cents per thousand, but now that it has been advanced to $1.50 he thinks that economy should be practiced. The Mayor claims that Supt. King figures out an annual saving of $40,000 to the city if the moon-table system is adopted."

CONSOLIDATED.—Some months ago we noted that a war of gas rates had been inaugurated at Poughkeepsie, N. Y. The fight is now, however, a thing of the past, the old Poughkeepsie Company having purchased the plant of its rival, the Citizens Company, established years ago by Mr. A. L. Allen. We understand that both plants will be kept in operation, at least through the winter. President Atwater evidently is a keen business man, and knows how to cleverly accomplish a good stroke of commercial policy. Mr. Allen, of whom it may be said that he always was an honest opponent, is hereafter to occupy the position of advisory agent to the consolidated company.

AN explosion occurred in the cellar of the purifying house of the Frederick City (Md.) Gas Company on the morning of Nov. 19. The damage was slight.

BENJ. FREIDBURG has received a franchise guaranteeing him the exclusive right to construct, maintain, and operate an electric light works in Kansas City, Kansas.

CHEAPER GAS FOR BIRMINGHAM, CONN.—Mr. Nettleton, General Manager of the Derby Gas Light Company, of Birmingham, having shown the fraternity (by means of his paper on residual products, read at the last meeting of the American Gas Light Association) how to handle and dispose of such products, now comes forward with a practical reminder of the benefit that accrues from careful working. On the first of November his Company instituted a selling rate of $1.60 per 1,000. Those who during the twelvemonth will have paid to the Company $500 for gas are to receive a rebate of 10 cents per 1,000, an annual payment of $1,000 securing a rebate of 20 cents per M. Large users consequently obtain their gas at $1.50 or $1.40, according to quantity annually used. The Derby Company leases Lungren burners at a monthly rental of 25 cents each.

Mr. Emil Lenz was united in marriage, on the 29th ult., to Miss Liddy Sonntag. The ceremony was performed in the German Lutheran Church, Stapleton, S. I.

THE Mansfield Gas Lighting and Heating Company will soon be in the field for public favor at Mansfield, Mass. This place is 24 miles south by west of Boston.

Frank Richardson, of the North Adams (Mass.) Gas Company, has been elected Treasurer of the United Zylonite Company. Good luck, Bro. Frank.

Notes from the West.

By RETORT.

Anna (Ills.) is to have an Edison electric lighting plant, providing the city authorities will contract for 200 lamps of 20-candle power each.

The Vandalia (Ills.) City Council recently passed an ordinance granting a 30-year franchise to Messrs. Geo. W. Brown and D. M. Clark, of that city, for laying mains and selling either natural or artificial gas to the residents. They propose to bore for the natural, failing to find which they will erect suitable works for manufacturing the artificial article.

Indianapolis, Ind., has for the past two weeks been engaged in a movement looking to the raising of $500,000 by popular subscription, the purpose being the piping of natural gas to the city, the same to be furnished to consumers—particularly manufacturers—at cost. The canvass was vigorously prosecuted, and at a meeting, held on the 19th ult., announcement was made that the entire amount had been secured. The organization is known as the Consumers' Gas Trust, and operations will be begun at once. The movement is of a purely popular character, the number of subscribers exceeding 4,500. It is claimed that this Trust will be able to furnish natural gas at lower prices than in any other city in the country. The gas will be brought a distance varying from nine to twenty miles, and the organization of the Trust is such that perpetual competition is assured.

The recent annexation of Hyde Park to Chicago has given rise to some points of interest to the recently-formed Gas Trust. The Chicago press has been very bitter against the Trust ever since the price was raised from $1 to $1.25 per thousand, and in the advent of the Hyde Park Gas Company they claim to see the relief sought for. The Hyde Park Company manufactures gas under the Fahnehjelm process, and great stress is put upon the fact that gas is sold at 50 cents per thousand. Of course, to the press all gas is alike, and no mention is made of the comparative lighting values of entirely different gases. In this way advantage is taken of the public, who, upon reading the articles, conclude that the Fahnehjelm gas is identical with that furnished Chicago's gas consumers in general, therefore not noting any reason why gas should sell in one place for $1 per thousand and 50 cents in the other, readily swell the cry of "thief and robber." Already the press is urging upon the public the importance and necessity of extending the powers of the Hyde Park Company, to enable the latter to lay pipes and distribute gas over the entire city. It is claimed that the Hyde Park Company is ready to enlarge its plant to meet the demand upon it. Another scheme urged with great vigor is that the city erect and operate its own plant; and a bill providing for this is now pending in the City Council. With all these various schemes in force the Chicago light question bids fair to be lively for the immediate future.

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FRIDAY, DECEMBER 2, 1887.

Death of General E. W. Leavenworth.

Just before going to press we received the following letter, which we regretfully place before our readers—

THE GAS LIGHT CO., SYRACUSE, N.Y.,
SYRACUSE, Nov. 28, 1887.

To the Editor AMERICAN GAS LIGHT JOURNAL:

Our President, General E. W. Leavenworth, died at his residence in this city, Saturday morning last, at the ripe old age of 85 years. General Leavenworth has been identified with the growth and prosperity of our beautiful city for the past 60 years, having seen it grow up from a hamlet to a city of 90,000 inhabitants. He has been identified with the establishment of very many of the business enterprises of the city, and was foremost in founding and promoting various churches and charitable institutions. He was a leading citizen, socially and politically; his services in the latter capacity being acknowledged by his having been called upon to fill various important places in our Municipal and State Governments, as well as in the affairs of the Nation.

The General had been connected with our Company since 1853, and, for 27 years, was active in the management of its affairs, most of the time acting as its President. He took great interest in gas matters in a general way, and was a pronounced believer in the efficacy of gas light associations organized to promote the interests of gas companies. As early as 1858 the deceased, with others, organized an Association of Gas Light Companies of the State of New York, General Leavenworth being its first President. This, I believe, was the first gas light association organized in this country. He was also present at the first meeting of the American Gas Light Association, and materially assisted in perfecting its organization, in April, 1873.

There was a very large attendance at the funeral services, and the evidences of respect for the deceased, who had departed this life after a career of great activity and public usefulness, were many and sincere. The numerous organizations with which General Leavenworth had been connected, paid feeling tributes to his memory, and just recognition of his part in life's busy activities, and they were represented by delegations attending the funeral services. In the carriages which formed the funeral procession, besides the members of the family, were the trustees of the First Presbyterian Church; trustees of the Syracuse Savings Bank; trustees of the Syracuse Gas Light Company; also the trustees of the Syracuse Water Works, and representatives from other organizations with which the deceased was identified.

Yours very truly, A. C. WOOD.

The Market for Gas Securities.

The city gas share market was featureless during the fortnight, but values were fairly well maintained. The Consolidated Company has declared a dividend of 2 per cent., payable on and after 15th inst., to stockholders of record of Nov. 30. The transfer books will be reopened on the 16th.

The earnings of the Company were quite satisfactory during the six months, and from the surplus carried over we expect that the June return to stockholders will be at least at the rate of 5 per cent. per annum.

A meeting of the stockholders of the Equitable Company will be held at the office, 640 Third avenue, on the 13th inst. If we had any Chicago Gas Trust shares we would be inclined to part with them, even at ruling figures.

Baltimore securities are weaker, but Consolidated looks like a purchase, as does Louisville (Ky.) stock.

Cincinnati (Ohio) gas is a shade under previous figures.

Anyone who wants to dispose of old Poughkeepsie (N. Y.) gas can find a purchaser by writing to us, provided anything like a fair figure is asked.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 WALL ST., NEW YORK CITY.

DECEMBER 2.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100		72½
Central	440,000	50	30	—
" Scrip	220,000	—	47	57
Equitable	2,000,000	100	110	—
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	113
Mutual	3,500,000	100	90	92
" Bonds	1,500,000	1000	101	—
Municipal, Bonds	750,000		—	—
Northern	125,000	50	30	—
" Scrip	108,000			
Yonkers		50	—	80
Richmond Co., S. I.	300,000	50	50	—
" Bonds	12,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	100	103
Citizens	1,200,000	20	50	—
" S. F. Bonds	320,000	1000	—	103
Fulton Municipal	3,000,000	100	128	130
" Bonds	300,000		—	106
Peoples	1,000,000	10	60	63
" Bonds (5's)	368,000	—	97	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	72	76
Nassau	1,000,000	25	90	95
" Ctfs	700,000	1000	95	100
Williamsburgh	1,000,000	50	110	115
" Bonds	1,000,000	—	111	—
Out of Town Gas Companies.				
Boston (Mass.) Gas Co	2,500,000	500	220	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	140	145
" " Bonds.	45,000	—	—	—
Chicago Gas Trust	25,000,000	100	38½	39
Cincinnati G. & C. Co.	6,000,000	100	178	180
Consolidated, Balt.	6,000,000	100	57	57¼
" Bonds	3,600,000		107	107½
Chesapeake, Balt.	1,000,000	100	90	—
"	1,000,000		100	102
Consumers Toronto	1.000,000	50	192	—
Central, S. F., Cal.			—	84
Capital, Sacramento, Cal.			57½	60
Hartford, Conn	750,000	25	140	142
Jersey City	750,000	20	168	—
Laclede, St. Louis, Mo.	2,000,000	100	125	—
Louisville, Ky.	2,570,000	50	122	127
Little Falls, N. Y.	50,000	100	95	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	220	221
Memphis (Tenn.) Gas	750,000	100	—	—
" Bonds.	240,000	100	103	—
New Haven, Conn.		25	193	197
Oakland, Cal.			35¼	35½
Peoples, Jersey City		—	—	60
" " Bonds.			—	—
Paterson, N. J.		25	90	—
Rochester, N. Y.		50	75	80
Syracuse, N. Y.	350,000	25	—	—
St. Louis, Missouri	600,000	50	—	—
San Francisco Gas Co. San Francisco, Cal.	10,000,000	100	57¾	58
Washington, D. C.	2,000,000	20	210	—

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